

Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Fast Quantum Gates Using Dynamical and Geometrical Phase¹

VLADIMIR MALINOVSKY, ARL, 2800 Powder Mill Road, Adelphi, MD 20783, PATRICK HAWKINS, SVETLANA MALINOVSKAYA, Department of Physics and Engineering Physics, Stevens Institute of Technology, Hoboken, NJ 07030 — We propose and analyze an experimentally feasible scheme to design universal set of quantum gates utilizing dynamical and geometrical phases accumulated by a qubit during the excitation. Our scheme provides a possibility to employ strong femtosecond pulses while keeping all advantages of the Rabi solution regime. We design fast quantum gates (picosecond time scale) by choosing proper parameters of the chirped pulses as a way to control nonadiabatic coupling and to satisfy the adiabaticity conditions. We also demonstrate a possibility to control the dynamical and geometrical phases by controlling the relative phase between excitation pulses applied in the Raman configuration. Proposed Hadamard and phase-shift gates allow us to construct a universal set of single qubit gates by controlling the effective pulse area, relative phase and two-photon detuning. Implementation of a controlled-NOT gate based on the proposed excitation scheme is also discussed.

¹The authors acknowledge a partial financial support from DARPA HR0011-09-1-0008 and NSF PHY-0855391.

Vladimir Malinovsky
ARL, 2800 Powder Mill Road, Adelphi, MD 20783

Date submitted: 03 Feb 2011

Electronic form version 1.4