Extreme Harmonic Generation in an InAs Spin-Orbit Qubit

J. STEHLIK, M.D. SCHROER, Department of Physics, Princeton University, Princeton, NJ 08544, USA, M.Z. MAIALLE, M.H. DEGANI, Faculdade de Ciências Aplicadas, Universidade Estadual de Campinas - UNICAMP, R. Pedro Zaccaria, 1300, 13484-350 Limeira, SP, Brazil, J.R. PETTA, Department of Physics, Princeton University, Princeton, NJ 08544, USA — Strong spin-orbit materials have shown great promise in the field of quantum computation. Unlike conventional semiconductor materials, fast all-electrical control is achieved through electric dipole spin resonance (EDSR). In this work we explore EDSR in an InAs nanowire spin-orbit qubit. We observe signs of harmonic generation where spin flips occur at the resonance condition $nhf = g\mu_B B$, where $f$ is the applied frequency, $B$ is the magnetic field, $g$ is the $g$-factor and $n$ is an integer. Near the interdot charge transition we observe harmonics up to $n = 8$, indicating extreme harmonic generation. At far detuning we only observe the $n = 1$ resonance. Further, we find odd/even structure in the harmonic response: odd harmonics result in an increase in the leakage current while even harmonics result in its suppression. Finally we observe oscillations in the resonant current as a function of detuning. The striking detuning dependence suggests that the harmonics may be caused by Landau-Zener transitions occurring due to the anti-crossing between the differing charge states. Numerical simulations of the system are qualitatively consistent with this picture.

$^1$Funded by the Sloan and Packard Foundations, the NSF, and the Army Research Office. M.Z.M. and M.H.D. were funded by Fundação de Amparo à Pesquisa de São Paulo (Fapesp) and INCT-DISSE/CNPq, Brazil.

Jiri Stehlik
Department of Physics, Princeton University, Princeton, NJ 08544, USA

Date submitted: 15 Nov 2013

Electronic form version 1.4