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Extreme Harmonic Generation in Electrically Driven Spin Resonance[1]

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InAs nanowire double quantum dots offer a rich platform for studying single spin physics in a material with large spin-orbit (SO) coupling. The large SO coupling allows all electrical control of the electron spin through electric dipole spin resonance (EDSR).[2] Here an oscillating electric field of frequency f displaces the electron wave function, while a magnetic field with strength B is applied. Spin rotations occur when the resonance condition $hf = g\mu_{\mathrm{B}}B$ is met. Here g is the electron g-factor, h is Planck's constant, and μ_{B} is the Bohr magneton. We find that near zero interdot detuning efficient spin rotations also occur when $hf = ng\mu_{\mathrm{B}}B$, with n being an integer as large as 8 in our system.[3] The harmonics feature a striking odd/even dependence. While the odd harmonics show an enhancement of the leakage current, the even harmonics show a reduction. In contrast, we do not observe any measurable harmonics at large detuning. We link the presence of harmonics with additional anti-crossings present in the level diagram. This implies that harmonics are the result of Landau-Zener transitions occurring at multiple anti-crossings. Recent theoretical work supports this conclusion.[4]

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