Author Correction: Ultrafast hole spin qubit with gate-tunable spin-orbit switch functionality

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Correction to: *Nature Nanotechnology* <https://doi.org/10.1038/s41565-020-00828-6>, published online 11 January 2021.

In the version of this Article originally published, the dependence of the Rabi frequency of the hole spin qubit on the g -factor was stated incorrectly. We wrote that the Rabi frequency is proportional to the g -factor perpendicular to the external magnetic field ($g_{\perp}$), but, in fact, it is the g -factor parallel to the external magnetic field ($g_{\parallel}$) as shown in ref. 25 (Golovach, V. N., Borhani, M. & Loss, D.). Thus, the following sentence has been amended from “This effective field $\mathbf{B}_{\text{eff}}$ drives the Rabi oscillations, with Rabi frequency $f_{\text{Rabi}} = g_{\perp} \mu_B B_{\text{eff}}(t)/2\hbar$, with $g_{\perp}$ the g -factor along the direction of $\mathbf{B}_{\text{eff}}$ and thus perpendicular to $\mathbf{B}_{\text{ext}}$, and $\hbar$ Planck’s constant.” to “This effective field $\mathbf{B}_{\text{eff}}$ drives the Rabi oscillations, with Rabi frequency $f_{\text{Rabi}} = g_{\parallel} \mu_B B_{\text{eff}}(t)/2\hbar$, with $g_{\parallel}$ the g -factor along the direction of $\mathbf{B}_{\text{ext}}$, and $\hbar$ Planck’s constant.” Accordingly, the phrase “the g -factor along $\mathbf{B}_{\text{ext}}$ ” has been deleted from the sentence starting “Here, f_{MW} and P_{MW} are kept fixed...”

When measuring at a constant value of the external magnetic field B_{ext} , f_{Rabi} and l_{so} still depend on the g -factor (as in the original version). However, when measuring at a fixed resonant microwave frequency $f_{\text{MW}} = g_{\parallel} \mu_B B_{\text{ext}}/\hbar$, any change of the g -factor is compensated for by an inversely proportional change of B_{ext} , and the apparent g -factor dependence vanishes from the equation of the Rabi frequency, thus making the observation of a gate-voltage-dependent spin–orbit coupling strength more robust. This is now reflected in the corrected Article, as described below.

The following changes have been made: (1) in the sentence beginning “We extracted a spin–orbit length...”, ‘3 nm’ has been changed to ‘4 nm’; (2) in the sentence beginning “For SOI-mediated spin rotations”, ‘ $g_{\perp}$ ’ has been changed to ‘ $g_{\parallel}$ ’; (3) in the sentence beginning “We found remarkably short...”, ‘28 nm’ and ‘3 nm’ have been changed to ‘23 nm’ and ‘4 nm’, respectively. Also, the following paragraph has been amended from

“Therefore, the Rabi frequency depends on l_{so} , the a.c. electric field amplitude $E_{\text{MW}}(t)$ created through the periodic gate voltage modulation, B_{ext} , the quantum dot confinement Δ_{orb} and the g -factor. Despite an observed change of $g_{\parallel}$ with V_{M} (refs. 18,43) by a factor of 1.5 (Fig. 3c), the effect on the Rabi frequency was small: at a constant Zeeman energy, we can write $f_{\text{Rabi}} \propto f_{\text{MW}} g_{\perp}/g_{\parallel}$. Hence, if the g -factor anisotropy $g_{\perp}/g_{\parallel}$ is only weakly affected by gate voltages, as observed here (Supplementary Fig. 3d,e), then the Rabi frequency change is correspondingly small.”

to

“For measurements at a fixed microwave frequency f_{MW} as done here, the apparent g -factor dependence vanishes and the Rabi frequency depends only on the spin–orbit length l_{so} , the quantum dot orbital level splitting Δ_{orb} and the a.c. electric field $E_{\text{MW}}(t)$ created through the periodic gate voltage modulation (see Supplementary equation (1)).”

Subsequent to the above change, reference 43 now becomes reference 45, and has now been cited as follows: “Moreover, the variation of $g_{\parallel}$ (ref. 45) in Fig. 3c...” References 44 and 45 have been renumbered to 43 and 44, respectively.

Also, in the Supplementary Information, the correction to the g -factor results in its elimination from Supplementary equation (1), making the Rabi frequency independent of the g -factor for our measurements where the microwave frequency was held fixed, as previously discussed; the corrected equation is:

$$f_{\text{Rabi}} = f_{\text{MW}} \cdot \frac{l_{\text{dot}}}{l_{\text{so}}} \cdot \frac{e |\mathbf{E}_{\text{MW}}(t)| l_{\text{dot}}}{\Delta_{\text{orb}}}.$$

The paragraph following Supplementary equation (1) has been updated to read “Here, we used $f_{\text{Rabi}} = g_{\parallel} \mu_B |\mathbf{B}_{\text{eff}}(t)|/(2\hbar)$ with $|\mathbf{B}_{\text{eff}}(t)|$ as defined in Eq. 1 of the main text, and $|\mathbf{B}_{\text{ext}}(t)|$ is converted to f_{MW} via the resonance condition $g_{\parallel} \mu_B |\mathbf{B}_{\text{ext}}(t)| = \hbar f_{\text{MW}}$, since f_{MW} is held fixed. In order to stay on resonance, we compensate the variation of $g_{\parallel}$ (shown in Figure 3 c of the main text) with a proportional change of $|\mathbf{B}_{\text{ext}}(t)|$ in the opposite direction, effectively making f_{Rabi} independent of $g_{\parallel}$. We note that $l_{\text{dot}} = \hbar/\sqrt{\Delta_{\text{orb}}} m_{\text{eff}}$ with the effective hole mass m_{eff} ”

The related discussion in the Supplementary Information has also been updated as follows: (1) the paragraph beginning “Lastly, the Rabi frequency...” has been changed to “In conclusion, we estimate the contributions from changes in electric field amplitude (no change) and orbital level splitting to account for a total of not more than a 1.5-fold change of the Rabi frequency. The very large change of the Rabi frequency by a factor of 7 can therefore be attributed mainly to an electrically tunable spin–orbit interaction, as expected from a direct Rashba type of spin–orbit interaction”; (2) the sentence beginning “In order to see the effect of...” has been changed to “We also study the evolution of the g -factor in other directions as a function of V_{M} ”; (3) the sentence beginning “Figure S3 c shows these...” has been changed to “Figure S3 c shows g -factors in two directions that are perpendicular to the orientation of $\mathbf{B}_{\text{ext}}$ as function of V_{M} , extracted from measurements of the Larmor frequency”; (4) the sentences beginning “These two directions...” and “While these changes in anisotropy...”

have been deleted; (5) in the sentence beginning “The corresponding values...”, “ $|E(t)|, g, \Delta_{\text{orb}}$ ” has been changed to “ $|E(t)|, \Delta_{\text{orb}}$ ”; (6) the sentence beginning “For the g -factor...” has been changed to “For Δ_{orb} we take the values shown in Figure S3 b, which were obtained from measurements of bias triangles”; (6) in the sentence beginning “For the measurement with V_{M} ...” ‘3 nm (20 nm)’ has been changed to ‘4 nm (26 nm)”; (7) in the Figure S4 caption, “measured values of g, Δ_{orb} ” has been changed to “measured values of Δ_{orb} ”.

The conclusions of the Article are unaffected.

The online versions of the Article have been amended and the Supplementary Information file replaced.

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Author Correction: The current landscape of nucleic acid therapeutics

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In Table 2 of the version of this Review originally published, the nucleic acid therapeutic ‘Nedosiran’ was incorrectly listed as a GalNAc–ASO conjugate, but it is a GalNAc–siRNA conjugate. Table 2 has now been amended accordingly in the online versions of the Review.

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