In this corrigendum to the paper by Livadaru et al (2010 New J. Phys. 12 083018) we point out an omission in one of the equations describing the decoherence analysis for silicon dangling bond qubit systems due to electron–phonon interactions. We also provide a corrected version of the equation and of the subsequent calculations and results in the paper and discuss the implications for the overall decoherence rate in DB charge qubits.

The omission of a factor of \( c_{i} \) in the denominator of equation (23) was found. Thus, the correct form of the rate of acoustic phonon emission is

\[
\Gamma_{e-ph} = \frac{64D^2q^3\sin^2\theta}{\pi\rho\hbar c_i^2} \left( \frac{n_B(E, \Theta)}{(q\Delta\epsilon)^2 + 4}\right) \left(1 - \frac{\sin qd}{qd}\right),
\]

where \( c_i \) is the longitudinal sound velocity in silicon, \( \rho \) is the density, \( D \) is the deformation potential, \( d \) is the dot separation, \( q \) the phonon wavevector, \( E \) the phonon energy, \( a_B \) the renormalized Bohr radius, \( \Theta \) the lattice temperature, \( n_B \) the Bose occupation distribution, and \( \theta = \tan^{-1}(\Delta / \epsilon) \), with \( \Delta \) and \( \epsilon \) the tunnel splitting and the applied bias on the qubit. We also corrected the value of \( \rho \) used in our initial calculation.

In figure 1 we plot the corrected decoherence rate as a function of intra-qubit dot separation together with the bare tunneling rates of the qubit and the decoherence rate due to the Johnson–Nyquist voltage fluctuations. For DB separations of 3.84 Å and 7.68 Å, the tunneling rates (4.67 × 10^{14} s^{-1} and 1.33 × 10^{14} s^{-1}, respectively) are denoted by circles, and tunneling rates for greater DB separations are calculated by the Wentzel–Kramers–Brillouin (WKB) method. The chosen values of inter-dot separation correspond to allowed DB–DB spacing on the H–Si(100)2 × 1 surface. Dashed lines joining different inter-dot separations facilitate direct comparison.

The most important consequence of this correction for our DB qubit is that the above decoherence rate \( \Gamma_{e-ph} \) is much lower than previously calculated and no longer the dominant rate. In fact, for separation less than 20 Å, \( \Gamma_{e-ph} \) is less than 10^{6} s^{-1}, namely \{3.12, 3.70, 4.48, 5.47, 8.25\} × 10^{5} s^{-1}, respectively for separations of {3.84, 7.68, 11.52, 15.36, 19.20} Å. These rates are calculated for \( T = 4 \) K, but the results are very weakly varying with temperature and are virtually unchanged at 77 K and just 5% higher at 300 K. Thus, in the absence of control and readout apparatus and other environmental perturbations, the \( T_2 \) times for the above separations are \{3.20, 2.70, 2.22, 1.83, 1.21\} × 10^{-6} s.

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12 Here, as in the original paper, \( s^{-1} \) is shorthand for \( \text{rad s}^{-1} \).
We also need to correct a typo in equation (11) giving the expression of decoherence rates due to Johnson–Nyquist noise. The denominator in the last fraction there should have been $E_k T$ instead of $Q E_k r$, so the correct formula is

$$\Gamma = \frac{\hbar}{2 \epsilon} \exp\left(\frac{-E_k}{kT}\right).$$

Our original calculations were not affected by this typo, as the correct formula was used to generate the original results.

The corrected $\Gamma_{\text{ph}}$ rates are much lower than the decoherence rates due to Johnson–Nyquist noise in the electrodes, $\Gamma_{\text{JN}}$. Thus, in a regime of interest, $d < 16 \text{ Å}$, we now identify $\Gamma_{\text{JN}}$ as the dominant decoherence rate with values of $1.30 \times 10^6 \text{ s}^{-1}$ at $T = 1 \text{ K}$, $5.24 \times 10^8 \text{ s}^{-1}$ at $T = 4 \text{ K}$, and $1.00 \times 10^{10} \text{ s}^{-1}$ at $T = 77 \text{ K}$. Furthermore, $\Gamma_{\text{JN}}$ decreases with increasing separation (see figure 1). We stress that the essential fact for our DB qubit is that, at low $T$, decoherence still occurs over several nanoseconds whereas the tunneling period for the DB–DB pair with a few Å separation is close to 10 fs, which enables many coherent qubit oscillations before decoherence sets in.

The consequences of this correction for quantum computing gates using DB qubits are as follows. The overall decoherence rates in the presence of control electrodes have not changed significantly, yielding error probabilities of the order of $10^{-6}$ for the single-qubit gate and $10^{-5}$ for two-qubit gate, at low $T$. These are well within the tolerance required by standard quantum error correction protocols.

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