Kitaev Algorithm

The magnetic moment of our artificial atom is:

$$\mu = S\hbar |d\omega_{01}/d\Phi|,$$

which is directly proportional to the area S and the rate change with flux Φ of the transition frequency ω_{01}. For our device we obtain $d\omega_{01}/d\Phi = -2\pi \times 5.3GHz/\Phi_0$ at the bias point, resulting in $\mu = 1.10 \times 10^5 \mu_B$.

Operating away from the bias point leads to a reduction of the decoherence time $T_2 : {T_2}^{-1} = (2T_1)^{-1} + {T_\Phi}^{-1}$, where $2T_1$ is a sum of relaxation time and T_Φ is a dephasing time. The dephasing rate appreciably increases at our bias point, which reduces T_2 and thus the number of available steps that can be implemented in the Kitaev algorithm.

In the experiment we apply a Ramsey sequence of two consecutive $\pi/2$ pulses separated by a time delay τ, which corresponds to an effective spin-1/2 precession around the z-axis of the Bloch sphere. The precession angle $\phi = \Delta\omega(\Phi)\tau$ is defined by the frequency mismatch $\Delta\omega(\Phi) = \omega_d - \omega_{01}(\Phi)$ between the transition frequency $\omega_{01}(\Phi)$ of the transmon qubit and the fixed drive frequency ω_d of the $\pi/2$ pulses.