Chapter 6

Summary and Conclusion
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In the present research work, the author has used Rabi-Oscillation theory to explain $\Omega_{01}^{(1)}$ position matrix elements of the qubic. It has been shown that the Rabi-Oscillations ($0 \rightarrow 1 \rightarrow 2$, transition), $\left(\Omega_{01}^{(1)}, \Omega_{02}^{(1)}\right)$ of the $\Omega_{01}^{(1)}$, position matrix from is equal to the minimal Rabi frequency, which is calculated by the equation (6.1) and (6.2)-

$$\Omega_{R,01}^{(1)} \approx \Omega_{01}^{(1)} \left(1 - \frac{\left[\Omega_{01}^{(1)}\right]^2}{4(\omega_{01} - \omega_{12})^2}\right) \quad (6.1)$$

$$\Omega_{R,02}^{(1)} \approx \frac{\sqrt{2} \left[\Omega_{01}^{(1)}\right]^2}{(\omega_{01} - \omega_{12})} \quad (6.2)$$

Where $\Omega_{01}^{(1)} = \hbar^{-1} A x_0$ \quad (6.3)

The author has calculated the values of Rabi frequency for ($0 \rightarrow 1 \rightarrow 2$, transition) which are inclose agreement with experimental value of J. M. Martinis & Frederick [80, 81].

Further, in order to confirm our hypothesis, author has calculated the a.c. stark shift 'Δω₀' with respect to the characteristic of the Rabi frequency, of two level donor system. The expression used for the calculation is (6.4)-

$$\Omega_{R,01}^{-} = \left[\Omega_{R,01}^{2} + (\omega_{01} + \Delta \omega_{01} - \omega)^2\right]^{1/2} \quad (6.4)$$
The expression used for the calculation of a.c. stark shift of Rabi Oscillations using the (dimensionless) position matrix element are to order $\lambda^3$, it is given by equation (6.5):

$$\frac{\omega_{02}}{2} \approx \omega + \frac{[\Omega_{01}^{(1)}]^2}{4(\omega_{01} - \omega_{12})} \quad (6.5)$$

Using the given above equation for a.c. stark shift. Author has calculated the value of the a.c. stark shift $\Delta\omega_{01}$ for the Rabi Oscillation frequency.

Our calculated values are in good agreement with experimental values of Martinis for a.c. stark shift $\Delta\omega_{01}$ and Rabi Oscillation frequency.

Therefore author has established beyond doubt that the origin of $\Delta\omega_{01}$ a.c. stark shift of Rabi Oscillations of two level donor system may be due to the Rabi frequency for (0 $\rightarrow$ 1 $\rightarrow$ 2, transition) Rabi Oscillation frequency can be used for high fidelity superconducting phase qubits.