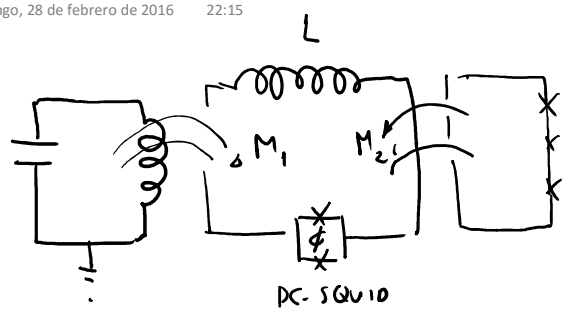
Problem 5

domingo, 28 de febrero de 2016 22:15



Assume a flux qubit that is inductively coupled trough an r-f- squid to a μ-wave resonator $H_{gb} = \frac{\Delta}{2}\sigma^z$, $H_{cav} = \omega a^\dagger a$

a) Write down the qualitative Hamiltonian that describes the qubit-cavity coupling

a') Optionally derive it from the circuit above

b) Assume $|\beta| \ll 1$ and show that the coupling strength "g" can be modulated periodically in time $g \sim \cos(\omega_d t)$

c) Show that for $\omega_d = 0$, the interaction Hamiltonian becomes, in the rotating frame

$$H_{int} \sim g_{eff}(\sigma^\dagger a + \sigma^- a^\dagger)$$

d) Using the rotating wave approximation, show that for suitable ω_d the effective Hamiltonian becomes, in the rotating frame

$$H_{int} = g_{eff}(\sigma^\dagger a^\dagger + \sigma^- a)$$

This is called a blue sideband.

e) Show that for a bicolor driving $g(t) \sim g_1 \cos(\omega_d^1 t) + g_2 \cos(\omega_d^2 t)$ the interaction becomes an arbitrary combination of rotating and counterrotating terms

$$H_{int} = g_{eff}(\cos(\eta)\,\sigma^\dagger a^\dagger + \sin(\eta)\,\sigma^- a^\dagger + H.c.)$$

where η and g_{eff} depend on g_1 and g_2