

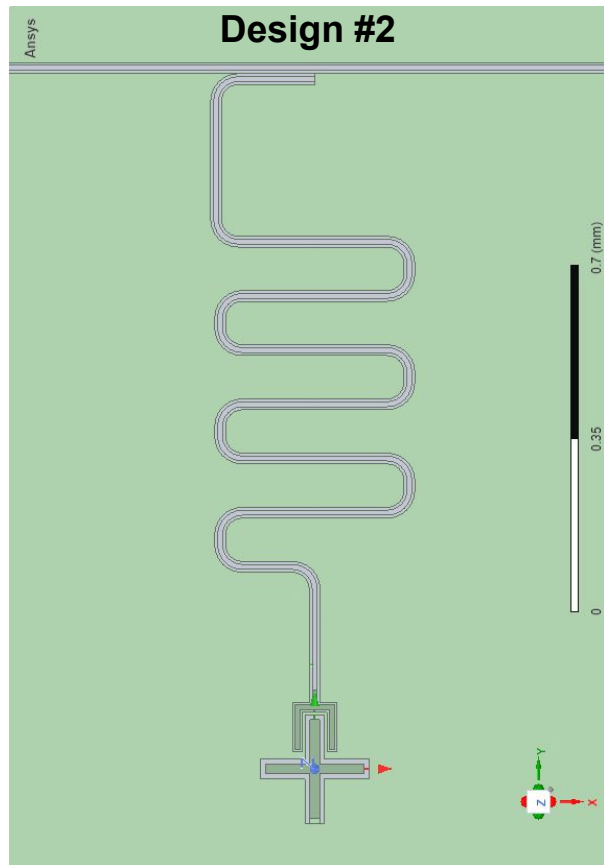
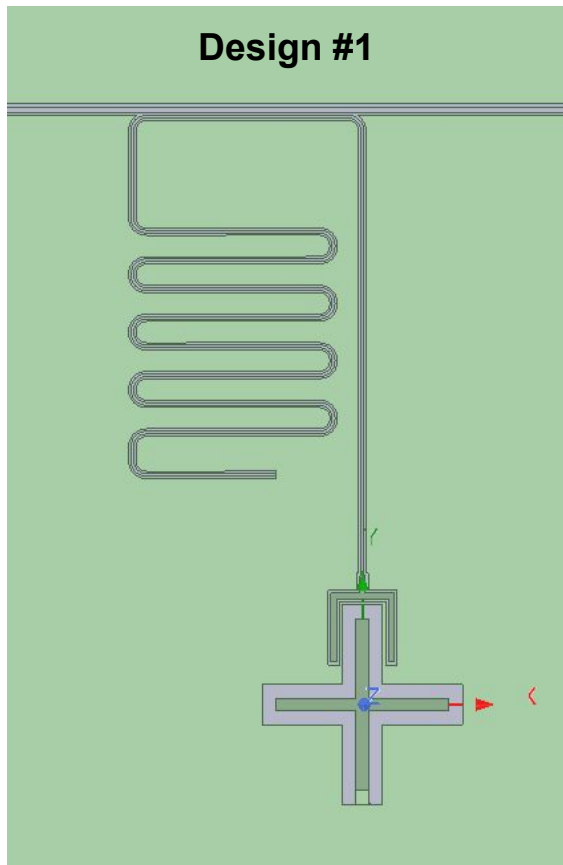
Qubit WP1

July 2022

Hervé Corti

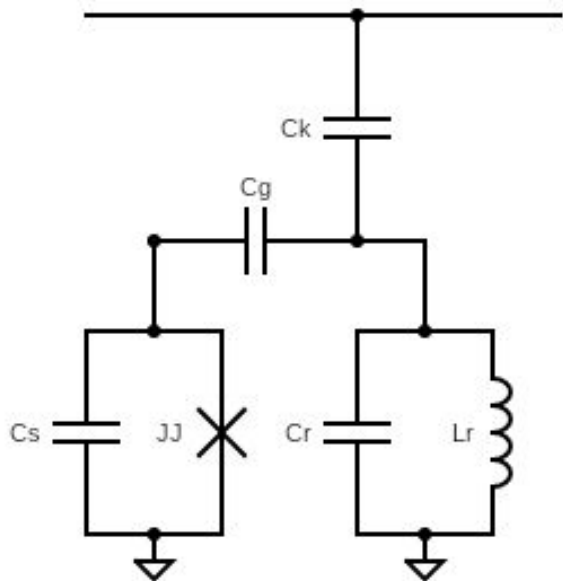
Danilo Labranca

Two designs



Design #1

From Claudio's
note



$$C_s = 69.72 \text{ fF}$$

$$L_J = 10 \text{ nH}$$

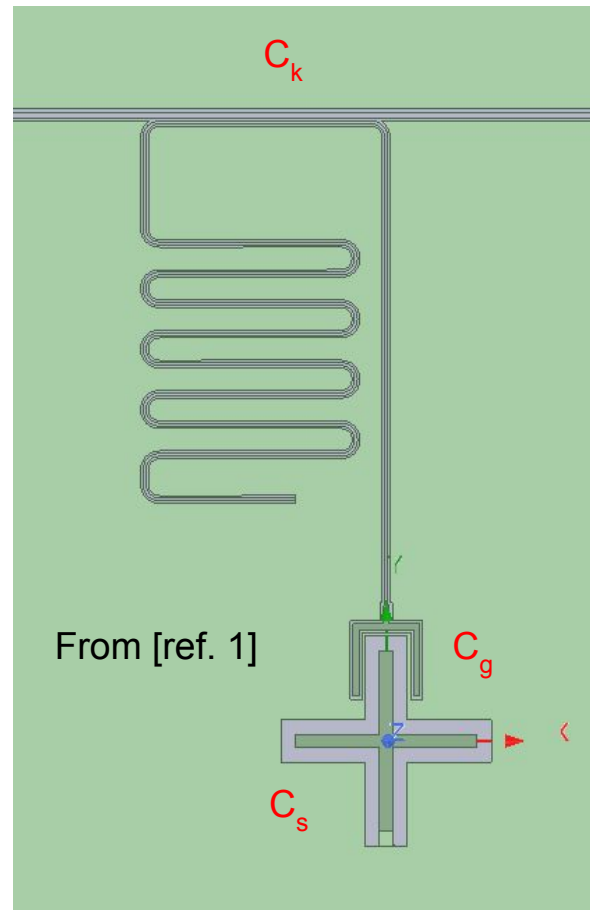
$$C_r = 375.08 \text{ fF}$$

$$L_r = 1.80 \text{ nH}$$

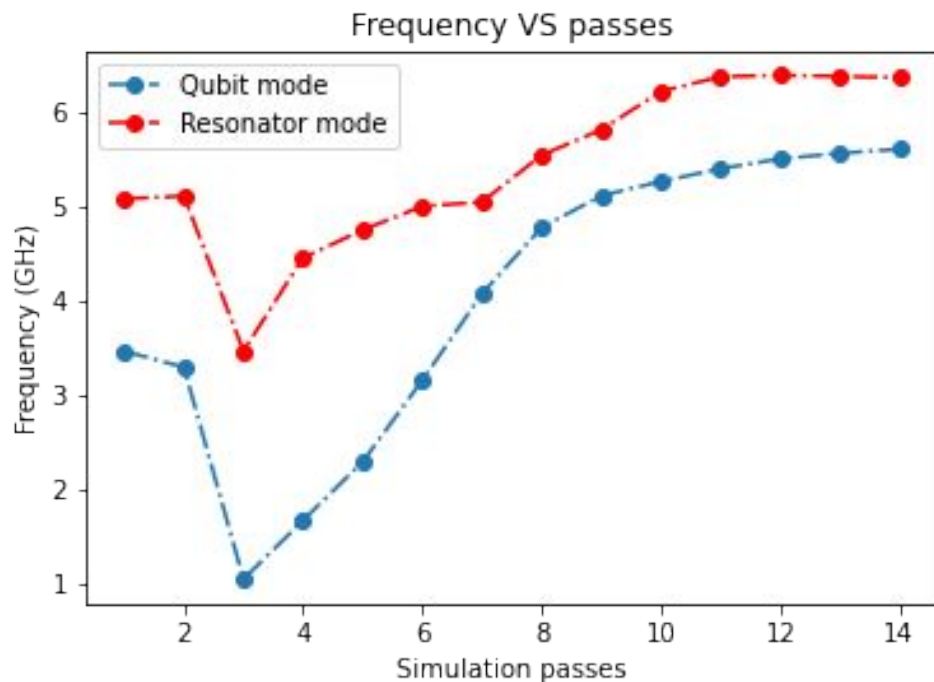
$$C_g = 3.09 \text{ fF}$$

$$C_k = 16.53 \text{ fF}$$

$$E_J/E_C = 61.61$$

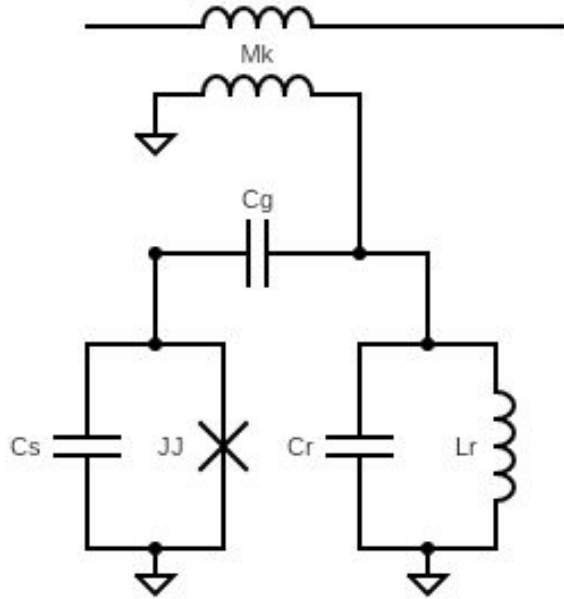


Design #1 - EPR simulation result



	EPR results	Calculated values
$\omega_{01}/2\pi$	5.367 GHz	5.632 GHz
$\omega_r/2\pi$	6.373 GHz	6.127 GHz
α	-264 MHz	-265 MHz
$\chi/2\pi$	-1.43 MHz	-2.23 MHz

Design #2



From Claudio's
note

$$C_S = 56.41 \text{ fF}$$

$$L_J = 8.00 \text{ nH}$$

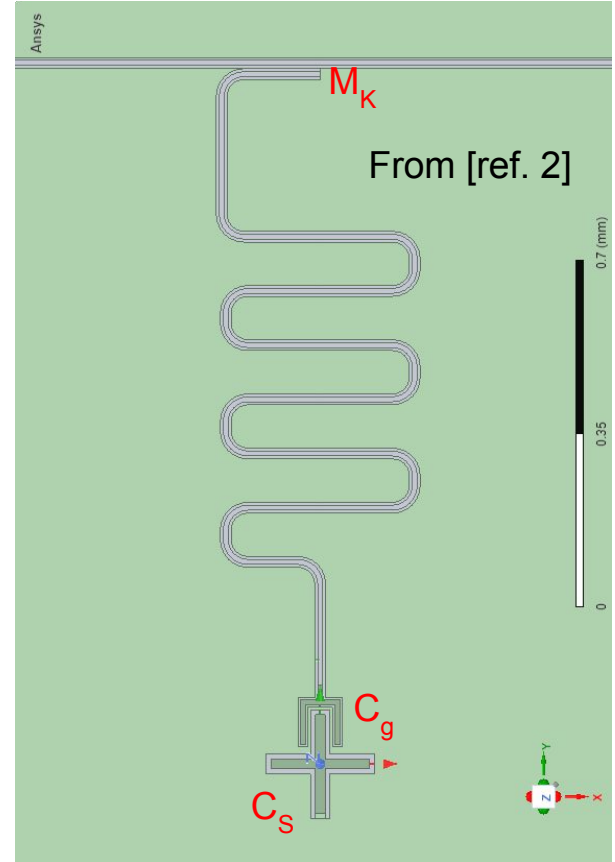
$$C_r = 301.35 \text{ fF}$$

$$L_r = 1.22 \text{ nH}$$

$$C_g = 3.14 \text{ fF}$$

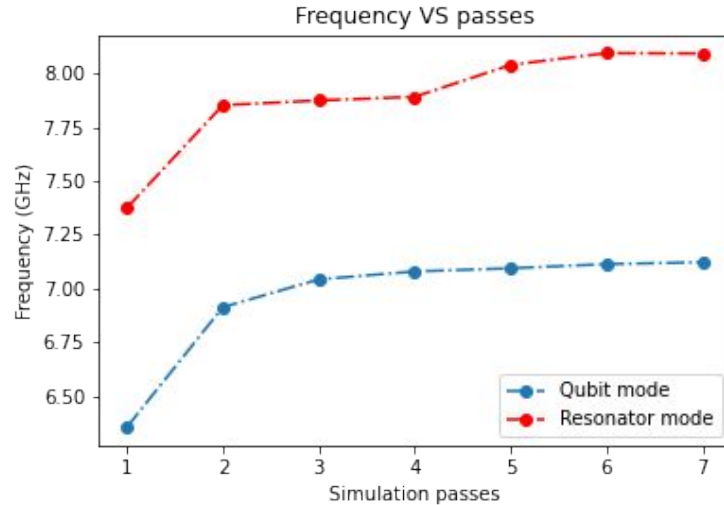
$$M_k = 15.08 \text{ pH}$$

$$E_J/E_C = 62.81$$



Design #2 - EPR simulation result

Note: all calculation was done substituting:
 $C_k = M_k / Z_0^2$ [ref. 3]



- ✘ Adaptive solution setup, process hf3d error: Failure in solving matrix. Please contact Ansys technical support. (10:56:38 lug 06, 2022)
- ⚠ Com Engine non-responsive since 10:56:58, July 06, 2022. Can be due to CPU intensive processing or network problems. If persisting for long, manually kill the com engine process and restart analysis. Retrying..... (10:57:58 lug 06, 2022)
- ✘ Machine Local Machine: Engine terminated unexpectedly, or machine reported error or was inaccessible. (10:58:57 lug 06, 2022)

	EPR results	Calculated values
$\omega_{01}/2\pi$	6.81 GHz	6.97 GHz
$\omega_r/2\pi$	8.09 GHz	8.04 GHz
α	-343 MHz	-325 MHz
$\chi/2\pi$	-2.75 MHz (-1.38 MHz)	-1.69 MHz

Probably it is 2χ
 (https://youtu.be/HJNKG5z6Jys?t=642)

Backup slide

Calculated values - From C.Gatti's note

$$E_J = \frac{\Phi_0 I_C}{2\pi}$$

$$\chi_{ij} = \frac{g_{ij}}{\omega_{ij} - \omega_r}$$

$$E_C = \frac{e^2}{2C_S}$$

$$\chi = \chi_{01} - \chi_{12}/2$$

$$\omega_{01} = \sqrt{8E_J E_C} - E_C$$

$$T_1 = \left(\frac{\Delta_0}{g_{01}} \right)^2 \frac{Q}{\omega_r}$$

$$g_{01} = 2\beta V_{RMS} \left(\frac{E_J}{32E_C} \right)^{1/4}$$

$$\beta = \frac{C_g}{C_g + C_s}$$

Calculated values - Design #1

$w_{01}/2\pi$ [GHz]: 5.62487603520033	Resonator width[MHz]: 52.74612474403946	beta: 0.04232296945623887
$w_{12}/2\pi$ [GHz]: 5.3595667717479385	Resonator width/ 2π [MHz]: 8.394806481955612	g_{01} [MHz]: 351.67089272050333
E_j [GHz]: 16.346151280678118	Resonator lifetime[us]: 0.018958738767116807	g_{12} [MHz]: 497.3377459771897
E_c [GHz]: 0.2653092634523917	V_{rms} [uV]: 2.321495168601686	$\chi/2\pi$ [MHz]: -2.2513532034421475
E_j/E_c : 61.61168693460018	$\Delta_0/2\pi$ [GHz]: -0.48924842876052216	T_1 [us]: 1.412465299815968
Loaded resonator freq[GHz]: 5.961517896391061	$\Delta_1/2\pi$ [GHz]: -0.7545576922129137	ncr: 19.102305076765568
Q: 710.1435761747655		P_{cr} [mW]: 5.366998805571736e-13
		P_{cr} [dbm]: -122.70268501365408
		$w_{rabi}/2\pi$ [MHz] @ P=-100dbm: 1.0465012407175585
		T_{rabi} [us] @ P=-100dbm: 0.9555650400512915

Calculated values - Design #2

$w_{01}/2\pi$ [GHz]: 6.966719646000583	Resonator width[MHz]: 14.106059947735478	beta: 0.05275052215644523
$w_{12}/2\pi$ [GHz]: 6.641422867430701	Resonator width/ 2π [MHz]: 2.245049168232704	g_{01} [MHz]: 555.3335367104214
E_j [GHz]: 20.43268910084765	Resonator lifetime[us]: 0.07089151780902048	g_{12} [MHz]: 785.360219256495
E_c [GHz]: 0.32529677856988193	V_{rms} [uV]: 2.9271094623676306	$\chi/2\pi$ [MHz]: -1.6908304781828314
E_j/E_c : 62.8124544936377	$\Delta_{01}/2\pi$ [GHz]: -1.0740190914217271	T_1 [us]: 10.319738675811761
Loaded resonator freq[GHz]: 7.926736828071766	$\Delta_{12}/2\pi$ [GHz]: -1.3993158699916084	ncr: 36.916111174368346
Q: 3530.763129928094		P_{cr} [mW]: 3.5685080998153145e-13
		P_{cr} [dbm]: -124.47513313142416
		$w_{rabi}/2\pi$ [MHz] @ P=-100dbm: 0.4916747175231783
		T_{rabi} [us] @ P=-100dbm: 2.033865001311275