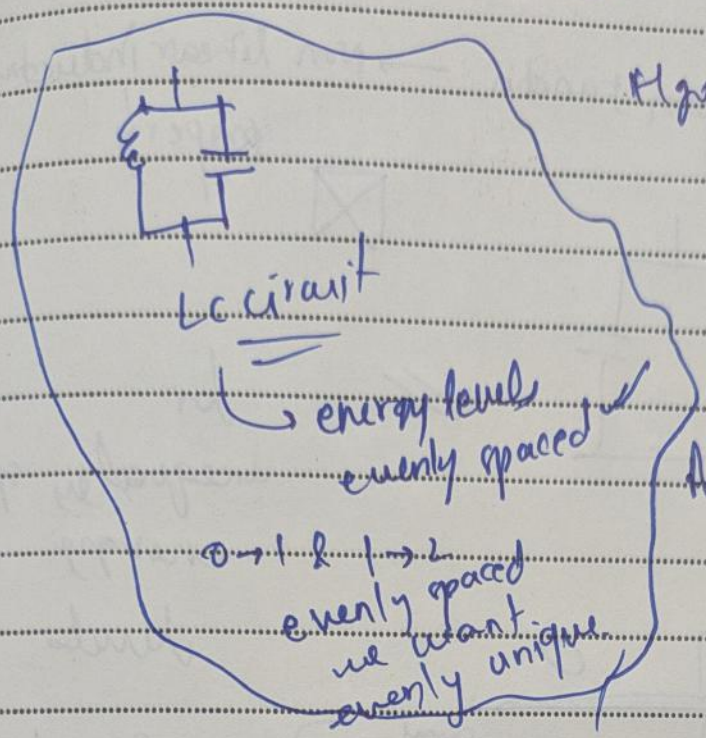
— Hari

Algs → characterizn → fabricn

transmon



LC circuit

↳ energy levels evenly spaced

0→1 & 1→2 evenly spaced we want unevenly unique

All harmonics levels are evenly spaced (freq of photon is same in all adj. / transition)

Duffing oscillator:-

$$\frac{\hat{H}_{Duff}}{\hbar} = \omega_1 a^\dagger a + \frac{q}{2} a^\dagger a a^\dagger a$$

harmonic — non harmonic

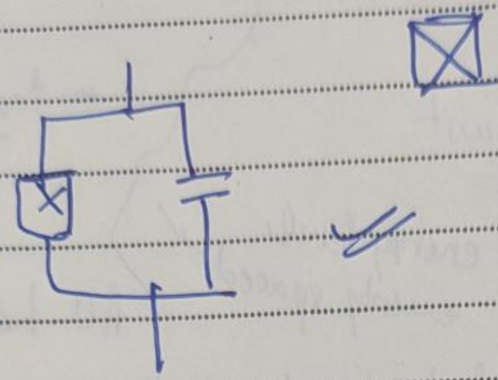
P_{12} Φ_1 P_2

Put 12 transmon gate

P_3

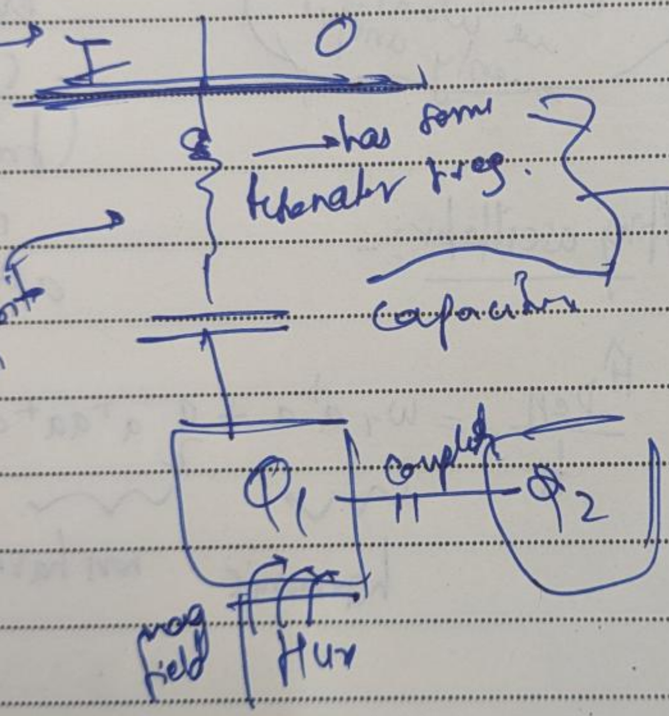
shape

Josephson junction → Non linear inductor property



for unequally spaced energy levels

f input



makes sure that qubit stays in the same state

Resonator like a linear LC circuit

Qubit changes certain value of resonator's frequency

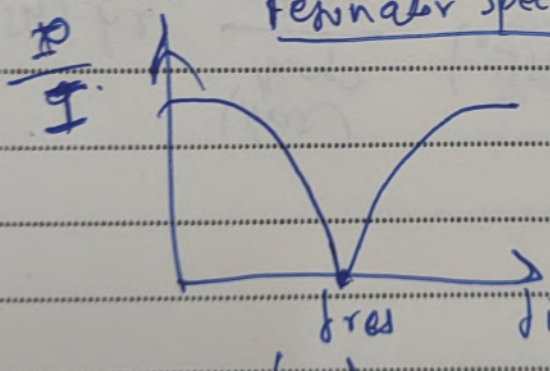
So we measure resonator rather than going & shooting a photon on a bare qubit to measure its state because it changes the state also.

QND → quantum demolition.

'superpos' always breaks no matter what.

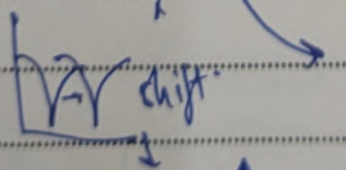
flux line: — constant dc voltage creates a field which changes frequency of JJ & that is the qubit!

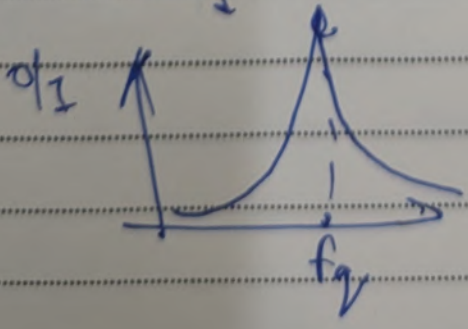
resonator spectroscopy



tweeping frequency & finding out what freq the resonator responds to ya!!

resonators resonating.





shape

* Amplitude modul^n
* Phase modul^n
* Truncation of th (spread)

Why Gaussian? ⟶ Fourier transform is =

When we change the phase of the drive pulse (photons that you send)

↓

We can change axis of measurement !!

2 DOF ⟵ in the Bloch sphere!!
θ, ϕ

$r_x(45°)$ $\xrightarrow{90° \text{ phase change (say)}}$ $r_y(45°)$

2 Qubit

flux tunable

DC

3 V

Q1

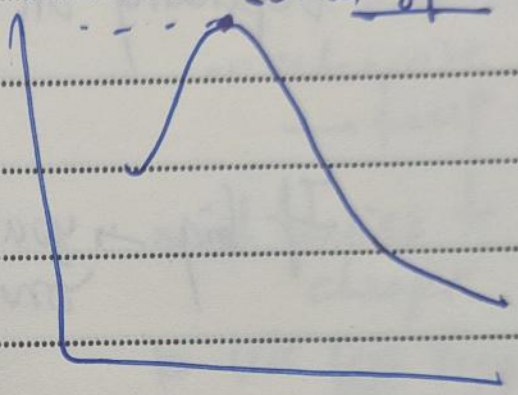
Q2

4.7 GHz

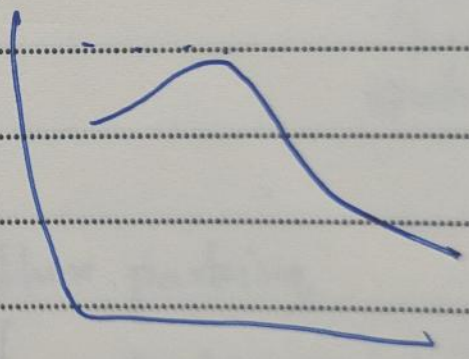
6.4 GHz

resonant frequency

Correct spot



Qubit freq

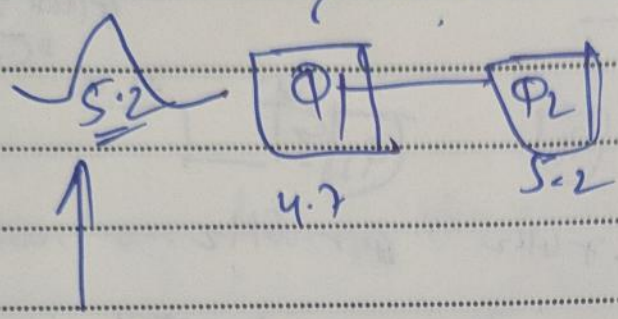


4.7 GHz → is the spacing the energy levels → not the exact energy levels.

TIFR → fixed frequency tuning

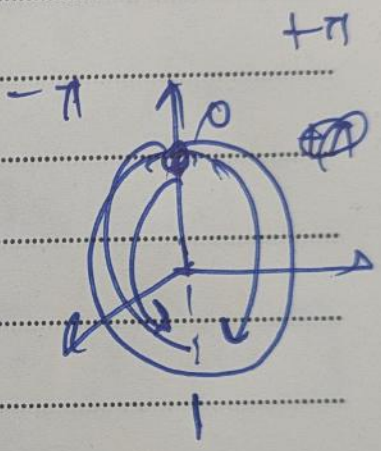
IBM's Cross Resonator Gate

→ imparts phase of π depending on $|1\rangle$ or $|0\rangle$



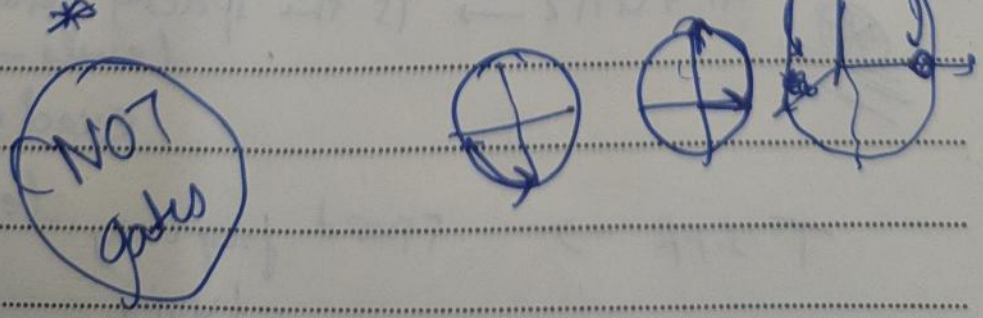
Depending on amplitude

If big → you reach one! no matter the phase



$+\pi$ $-\pi$

but if amplitude is half



Superconducting Qubits

→ have to be kept at mK temp.

but freq tunable by magnetic field

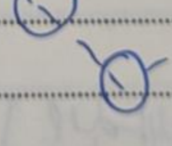
→ heat in current wire

→ temp ↑es

∴ much ~~easier~~ to cheaper to use ~~[illegible]~~ freq fixed/non-tunable qubits.

Flux parking.

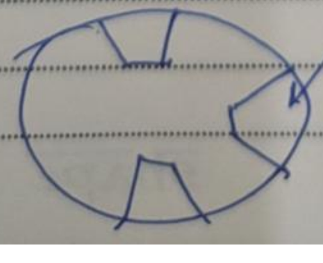
parking pulse



① park freq of adjacent down

(make only 2 communicate

trapezoidal capacitor



line impedance??

50 Ω ~~[illegible]~~ ___ shape

High density flux lines prob for google.

grid of

Read

(*) Myrohanga modes

modes

Myrohang function

(1) uantum resonator [Spectroscopy

(2) rabi oscillation (Amplitude duration) PuPiAI & TIFR (*)

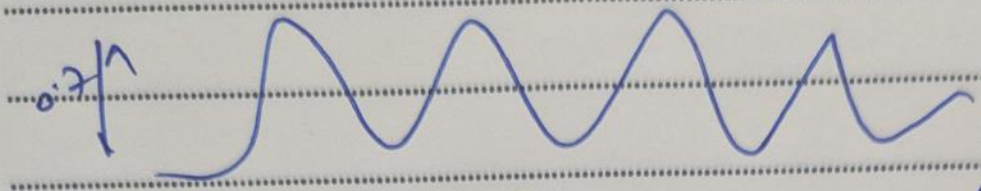
(3) phase...

(4)

rabi oscillation

shape

Rabi oscillation -



0.7 + E/7

increase duration

Half the amplitude