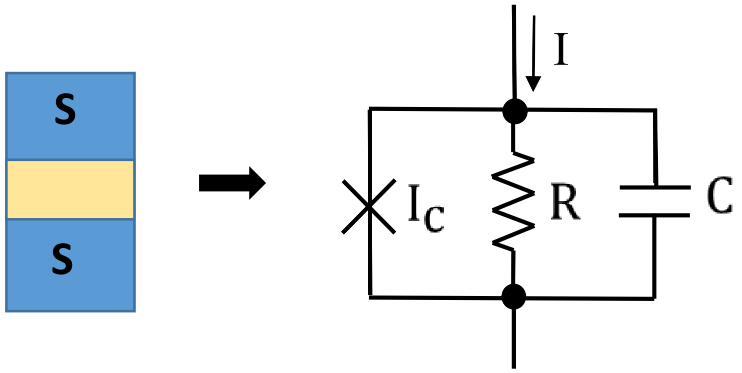
RSJ (Resistively-Shunted Junction) model

Model junction as a Josephson junction in parallel with a resistor and capacitance



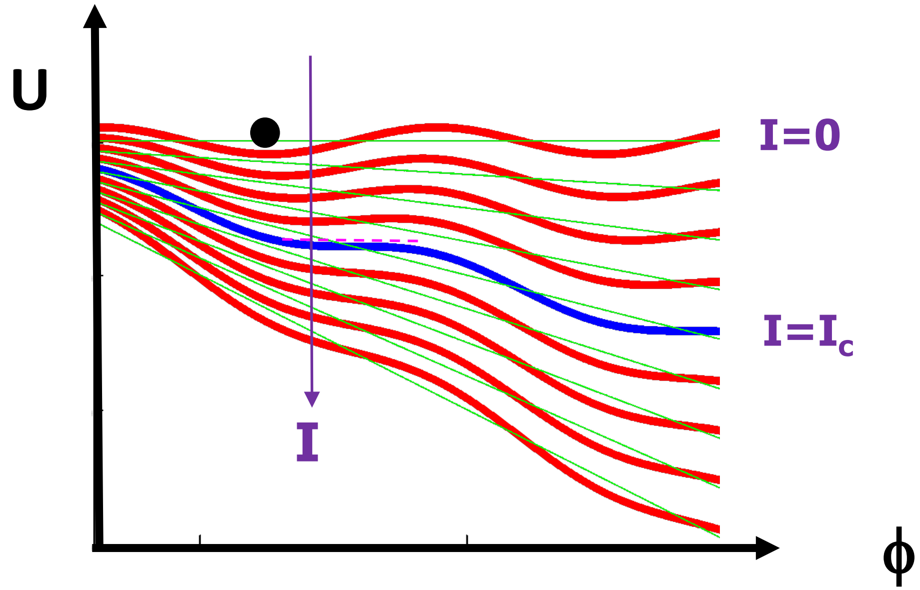
$$I = I_c \sin\phi + \frac{V}{R} + C\frac{dV}{dt} \qquad V = \frac{\hbar}{2e}\frac{d\phi}{dt}$$

$$I = I_c \sin\phi + \frac{\hbar}{2eR}\frac{d\phi}{dt} + \frac{\hbar C}{2e}\frac{d^2\phi}{dt^2}$$

$$\left(\frac{\hbar C}{2e}\right)\frac{d^2\phi}{dt^2} + \left(\frac{\hbar}{2eR}\right)\frac{d\phi}{dt} + \frac{\partial}{\partial\phi}\left(-I\phi - I_c\cos\phi\right) = 0$$

"mass" "damping" "potential"

Josephson dynamics: "phase particle" moving in a tilted washboard potential



I < I_c: static solution
ϕ = constant → V=0

I > I_c: dynamic solution
ϕ evolves in time → V > 0
voltage oscillates at the Josephson frequency

Josephson inductance: $L_J = \frac{\hbar}{2eI_1\cos\phi}$

Plasma oscillations: $\omega_p = \frac{1}{\sqrt{L_J C}}$

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