1 Abstract to Introduction

Dissipative quantum phase transition, always occurs Josephson Junction system, when $R_Q = h/4e^2$.

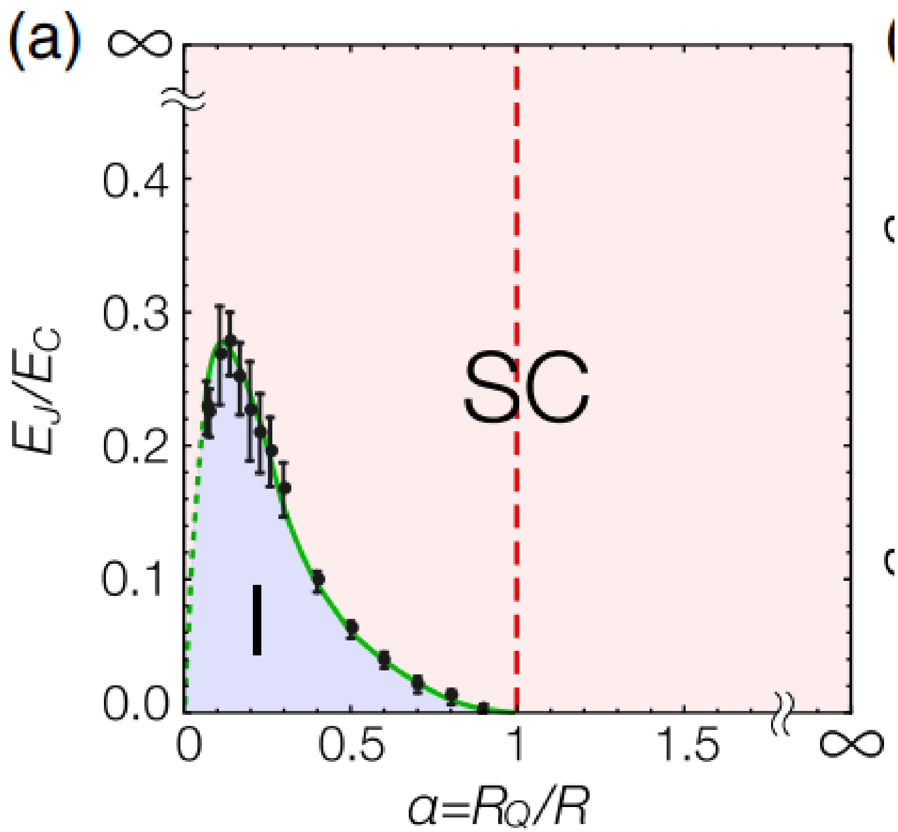

Figure 1: Figure 1-(a) in given paper, Result of functional renormalization group (FRG) and numerical renormalization group (NRG)

$E_C = (2e)^2/2C_J$: Charging energy with the capacitance C_J
E_J : Josephson coupling

$\alpha = R_Q = h/4e^2$: different dissipation strengths α. Transition occurs $\alpha < 1$.
If $R_Q/R(\propto \alpha)$ is decreased, results indicate the **reentrant transition**.
Dangerously irrelevant : $\nu \propto 1/E_C$, Capacitance term , it can turn into

$E_J/E_C << 1$	$E_J/E_C >> 1$
deep charge regime	transmon regime
?	Strong corrugation regime

relevant at low-energy scales due to nonperturbative renormalization.
$\rightarrow$ The reason that previous existed arguments missed.

2 Discussion

ν (Dangerously irrelevant term) : Safely neglected can one establish the duality between the weak and strong corrugation regimes.

$E_J/E_C \gg 1$: RSJ Hamiltonian tight-binding model of phase localized states ($\phi = 2\pi\mathbb{Z}$)
$\rightarrow$ Exhibits the transition at $\alpha_c = 1$,
$E_J/E_C \ll 1$: both tight-binding and duality argument are expected to be valid.
$\rightarrow$ results from given paper are consistent with the previous results predicting the transition at $\alpha_c = 1$ for any E_J/E_C.

Experimentally test for predictions : lowest transmission-line frequency $\omega_{min} = \pi v/L$.
Pre-requirements : renormalize to a sufficiently low-energy scale to attain small $\langle\cos(\phi)\rangle$ close to a fixed-point value;
Parameters : $\alpha = 0.3$, $E_J/E_C = 0.04$, $\hbar\omega_{min}, k_B T \lesssim 0.01 E_C$, to attain $\langle\cos(\phi)\rangle \lesssim 10^{-2}$.

These setup realized through the galvanic coupling of JJ to a high-impedance long transmission line.