NRG results and FRG results

April 7, 2023

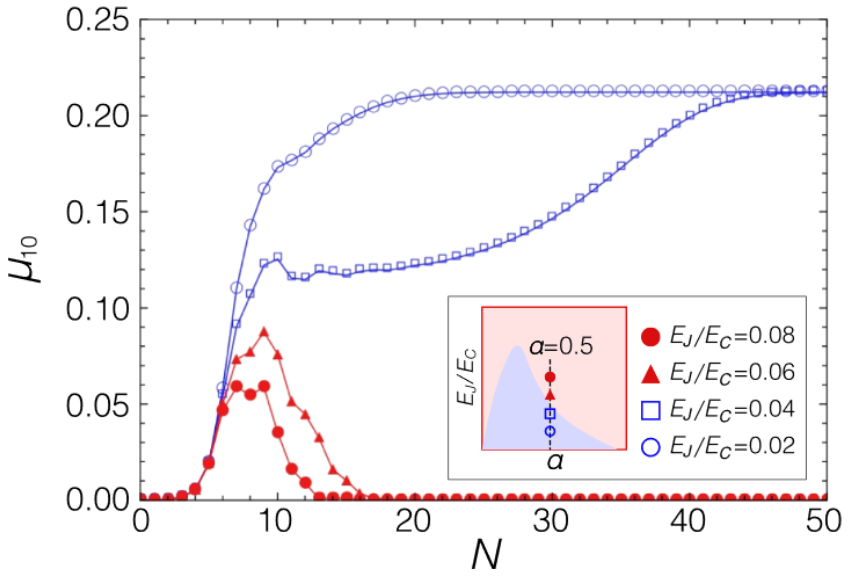

Figure 1: Figure.3 Typical NRG Flows of μ_{10} at $\alpha = 0.5$

RG procedure : beginning :
$\frac{E_J}{E_C} \leq 0.04$, $\mu_{10} \rightarrow$ grows, system : insulator phase.
$\frac{E_J}{E_C} \geq 0.04$ (Threshold value) , $\mu_{10} \rightarrow$ decreases
$\rightarrow$ determine critical values, method : extraplolting the wilson parameter. $\Lambda \rightarrow 1$ for each α

① behavior of $\langle \cos\phi \rangle$ and μ_{10} are **consist** with with other

$\langle \cos\phi \rangle = 0$, $\mu_{10} \neq 0$: insulator phase (delocalized phase?)
$\langle \cos\phi \rangle \neq 0$, $\mu_{10} = 0$: superconductor phase (localized phase?)
② $\langle \cos\phi \rangle$ and μ_{10} : indicate reentrant into SC phase

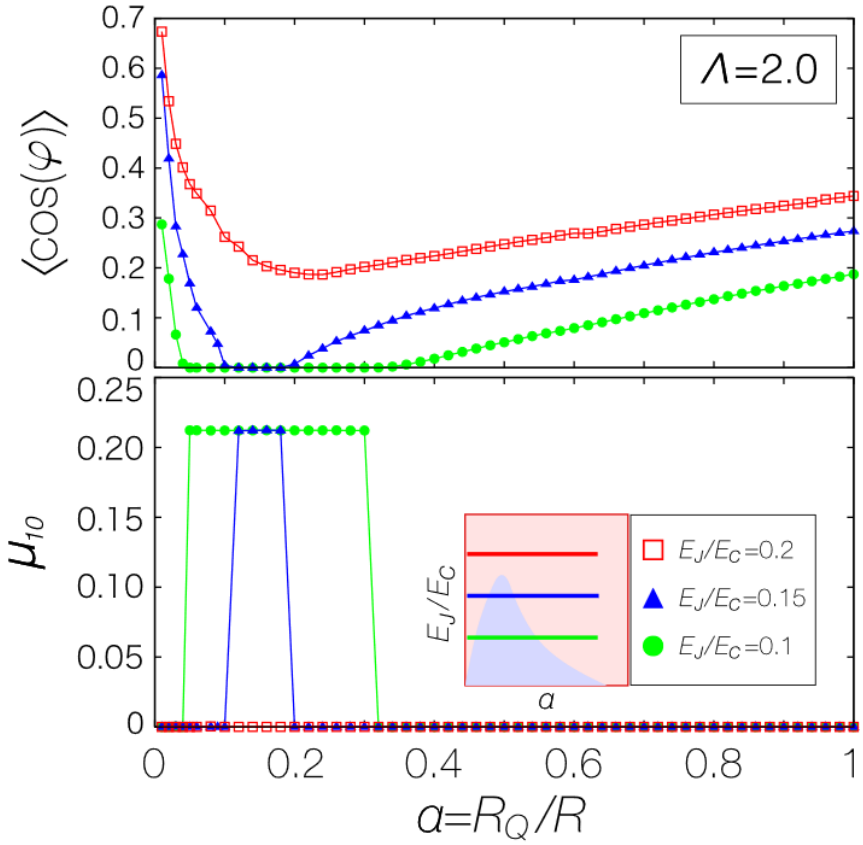

Figure 2: Figure.4 $\langle\cos(\phi)\rangle$ (phase coherence), μ_{10} (mobility) at diff α and $\frac{E_J}{E_C}$.

NRG results on a deeper level → nonperturbative analytical approach, **Functional Renormalization Group**
⟨functional anstanz⟩ :
① most relevant Fourier model
② $\cos(\phi)$
③ local potential approx.

flow equations :
$d_J \ln \epsilon_J = 1 - \int_0^\infty \frac{dy}{\pi} g(y)$
$d_C \ln \epsilon_C^{-1} = -1 + \epsilon_J^2 \int_0^\infty \frac{dy}{\pi} h(y)$

DQPT : Dissipative Quantum Phase transition

presence of DQPT : at α_c =1
absence of DQPT : at $\alpha < 1$