Benchmark results : The boundary sine-Gorden model

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$\hat{H}_{bsG} = -E_J \cos\left(\frac{\hat{\phi}(0)}{\sqrt{\alpha}}\right) + \hat{H}_T LL$: boundary sine Gordon model

1 $\alpha = 1 \quad \rightarrow$: transition
2 $\alpha > 1 \quad \rightarrow E_J$: irrelevant
3 $\alpha < 1 \quad \rightarrow E_J$: renormalizes to z=0

dc phase mobility : $\mu \equiv \frac{\alpha}{2\pi} \lim_{\omega \to +0} \omega \langle \psi\psi \rangle_\omega$
dc phase mobility in transformed frame : $\mu = \lim_{\omega \to +0} \sum_{n=0}^{\infty} \omega_{n0} \mu_{n0} \delta(\omega - \omega_{n0})$

ω_{n0} : nth excitation freq.
$\mu_{n0} \equiv \alpha |\langle 0|\hat{\Xi}|n\rangle|^2$: mobility matrix element (nth energy eigenstate)

For mobilty, :
1 $\mu \rightarrow 0$, SC Phase , $\alpha > \alpha_c$
2 $\mu \neq 0$, insulator Phase, $\alpha < \alpha_C$

wilson parameter? (what is this?), critical value : $\alpha_c(\Lambda)$,
Crossover scale $N(\alpha)$,
$N(\alpha) \propto (\alpha - \alpha_c)^{-1}$
$\Lambda \rightarrow 1$:locate transition point.

NRG result : consistent with the analytical value $\alpha_c = 1$, in the scaling limit $\epsilon_J = \frac{E_J}{\hbar W} \rightarrow 0$

previous study : Vertical phase boundary : $\alpha_c = 1$, ν is irrelevant.
UV Theory : Large capacitance term, $\nu \gg 1$, low-energy theory may go beyond perturbative regimes, $\nu \rightarrow$ (fixed point)