1 Landau-Zener Solution

The time depednent equations for the TFIM reduce to

$$i\hbar \frac{du_k}{d\tau} = -\frac{1}{2}(\tau\Delta_k)u_k + \frac{1}{2}v_k \tag{1}$$

$$i\hbar \frac{dv_k}{d\tau} = +\frac{1}{2}(\tau\Delta_k)v_k + \frac{1}{2}u_k \tag{2}$$

Here, τ depends on the time t and the quench protocol, while Δ_k is the gap parameter for mode k. The functions $u_k(\tau)$ and $v_k(\tau)$ describe the time evolution of the Bogoliubov quasiparticle amplitudes for each momentum mode k.

We can define them as follows:

$$\Delta_k^{-1} = 4J\tau_Q \sin^2(ka) \tag{3}$$

$$\tau = 4J\tau_q \sin(ka)(\frac{t}{\tau_Q} + \cos(ka)) \tag{4}$$