Counter-diabatic driving using Floquet engineering

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1 CD driving

$$H_0 = -J\sum_j (c_{i+1}^\dagger c_i + h.c) + \sum_j V_j(\lambda) c_i^\dagger c_i \tag{1}$$

For this problem, approximate gauge potential is chosen to be $A_\lambda^* = i\sum_j \alpha_j (c_{i+1}^\dagger c_i - h.c)$.

$$\begin{aligned} H_{CD} &= H_0 + \dot{\lambda} A_\lambda \\ &= -\sum_j J_j (c_{i+1}^\dagger c_i + h.c) + \sum_j U_j c_i^\dagger c_i \end{aligned}$$

where

$$J_j = J\sqrt{1 + (\dot{\lambda}\alpha_j/J)^2} \quad U_j = V_j(\lambda) - \sum_i^j \frac{J}{J^2 + (\dot{\lambda}\alpha_i/J)^2}(\ddot{\lambda}\alpha_j + \dot{\lambda}^2 \partial_\lambda \alpha_j)$$

2 Floquet driving

$$H_0 = -J\sum_j (c_{i+1}^\dagger c_i + h.c) + \Omega \sum_j \frac{\xi}{2}\sin(\Omega t - \Phi j + \Phi/2) c_j^\dagger c_j \tag{2}$$

Going to rotating frame defined by:

$$V = \exp(-i\sum_j \Delta_j c_j^\dagger c_j) \tag{3}$$

where $\Delta_j = \cos(\Omega t - \Phi j + \Phi/2)$