Formulae for Codes

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1. The Hamiltonian of system is

$$H = -J \sum_{n=1}^{L} [\, e^{-i\phi(t)} c_n^\dagger c_{n+1} \;+\; e^{i\phi(t)} c_{n+1}^\dagger c_n] \;+\; \sum_{n=1}^{L} \mu_n c_n^\dagger c_n \tag{1}$$

   where $\sigma = \frac{1+\sqrt{5}}{2}$

2. Aubry-Andre-harper quasi-periodic potential is given by

$$\mu_n = \mu_0 \cos\left(2\pi\sigma n + \alpha\right) \tag{2}$$

3. Pierel's phase is given by

   For sinusoidal electrical field

$$\phi(t) = \frac{A}{L} \sin \omega t \tag{3}$$

   For time-independent and space-independent constant field

$$\phi(t) = \frac{A}{L} t \tag{4}$$

4. Entropy is given as

$$S(t) = -\sum_{\alpha} [(1 - n_\alpha) \ln\left(1 - n_\alpha\right) + n_\alpha \ln n_\alpha] \tag{5}$$

   where n_α are eigenvalues of subsystem correlation matrices

5. The time evolution is given as, where D_{jk} is j^{th} component of k^{th} eigenvector of single particle Hamiltonian

$$U(t) = D^* (e^{-i\epsilon t}) D^T \tag{6}$$

$$C(t) = U^\dagger C(0) U \tag{7}$$

6. The charge current in system is given by

$$\langle j(t) \rangle = iJ(e^{i\phi(t)} C_{n,n-1}(t) \;-\; e^{-i\phi(t)} C_{n-1,n}) \tag{8}$$