

A toy model for quantum Monte Carlo

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Apply quantum Monte Carlo techniques to obtain approximate or exact ground state properties of the following toy model Hamiltonian of one particle in a one dimensional lattice:

$$H = -t \sum_{x=1, \dots, L-1} (c_{x+1}^\dagger c_x + \text{h.c.}) + t' \sum_{x=1, \dots, L-2} (c_{x+2}^\dagger c_x + \text{h.c.}) + V \sum_{x=1}^L x c_x^\dagger c_x \quad (1)$$

where $L = 30$ $t = 1$ $V = 1$, $t' = 1/8$ and $1/2$. In the latter case determine the exact ground energy by sampling the sign and/or provide a rigorous upper bound with the so called lattice fixed node approximation.