

Homework for August 2

Consider a lattice Hamiltonian for one non-relativistic particle interacting with a delta potential at the origin with coupling c ,

$$H(c) = H_0 + cH_1$$
$$H_0 = -\frac{1}{2m} \sum_{\vec{n}} \sum_{l=1,2,3} a^\dagger(\vec{n}) \left[a(\vec{n} + \hat{l}) - 2a(\vec{n}) + a(\vec{n} - \hat{l}) \right]$$
$$H_1 = a^\dagger(\vec{0})a(\vec{0})$$

Find the ground state energy of this system in a cubic periodic lattice of length 20, mass m equal to 1 (in lattice units), and coupling c ranging from 0 to -10 (in lattice units).

Now use eigenvector continuation with training values $c = 0.0, -0.2, -0.4, -0.6, -0.8$ to find a variational approximation to the ground state energy for coupling c ranging from 0 to -10 (in lattice units) using the first one, two, three, four, and five training eigenvectors.

Results should look like this:

