

Ansatz:

Where is an index that runs over all unit cells.

Schrödinger equation:

Where and . We also use:

Multiply both sides by :

And

So we get the equation:

Which can also be written as

Multiply both sides by we get a similar equation:

Or in matrix form:

The eigenvalues (energies) are calculated from:

With the solutions

The eigenstates are found using the matrix equation we found before. Taking the first row:

After rearranging

So after finding and choosing randomly, we can calculate . Then we plug these into

To find the system eigenstate at that particular .

In particular we can choose the interaction to be dipole-dipole. In this case