

## Peer Review

# Review of: "Towards Quantum Simulation of Lower-Dimensional Supersymmetric Lattice Models"

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The authors study the supersymmetry breaking of the 0+1 supersymmetry quantum mechanic model with various supersymmetry potentials. They use the VQE method to find the ground state energy, determining whether the supersymmetry is broken. Overall, their research content is novel and interesting, their methods are feasible, and their results are reasonable.

I have only a few minor comments and suggestions:

1. In the VQE results section, the word “exact” is used in several places and has different meanings. In most cases, it is used for the exact diagonalization results, but it is also used for results from simulation without shot noise. I think this can be a little confusing, especially for readers who are not very familiar with the details of quantum computing. I suggest using different words for these two sorts of results.
2. As the author mentioned, the Hamiltonian should be positive semi-definite before truncation, with only non-negative energies. However, after truncation, the Hamiltonian with AHO potential has negative ground-state energy. Is this a severe problem? Is it a general phenomenon or a result of the specific truncation method used in this study? A brief discussion could be helpful.
3. Some details of the quantum algorithm are not discussed. What is the reason for using the Realamplitude ansatz against other options? Also, it is a little strange that the required Pauli strings increase so rapidly with the number of qubits. For example, the harmonic oscillator potential essentially describes no interaction between the boson and the fermion. Yet, the number of Pauli strings is still the power law of the number of qubits. This may significantly affect the accuracy of results at large Lambda. Can this be improved by optimizing the mapping procedure?

These questions may be trivial to experts in the corresponding fields, but I think clarifying them is helpful to a broader range of readers.

## **Declarations**

**Potential competing interests:** No potential competing interests to declare.