

Quantum computing for nuclear physics

Pooja Siwach*

*Nuclear and Chemical Science Division,
Lawrence Livermore National Laboratory, Livermore, California 94551, USA*

Solving a quantum many-body problem with conventional (classical) computers demands resources that scale exponentially with the system size (number of particles and degrees of freedom). To resolve this issue, Feynman envisioned simulating a quantum system with another quantum system that follows the same laws. A quantum computer is a device of such kind. Quantum computing is no more only a mathematical formulation. The realization of quantum devices has interested many scientists to explore their usefulness in solving the quantum many-body problems. The nuclear many-body problems being similar to and different from other quantum many-body problems at the same time are an excellent ground to harness the real quantum computer. Several efforts are being put in this direction. Various algorithms have been explored to solve the quantum many-body problems encountered in quantum chemistry and condensed matter physics on a quantum computer. The nuclear systems are also explored with these algorithms. However, the nuclear many-body problem has special features due to the short-range interaction and several symmetries, which makes it different from quantum many-body problems encountered in other fields. Consequently, the quantum algorithms devised for the latter are not efficient enough for the nuclear many-body problems. Therefore, novel algorithms employing the knowledge of nuclear properties should be developed. I will talk about our attempts made to simulate the nuclear many-body systems on quantum computers.

Acknowledgments

This work was partly performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344.

[2] D. Lacroix, E. A. R. Guzman, P. Siwach, Eur.Phys.J.A **59**, 1 (2023).

References

[1] P. Siwach and P. Arumugam, Phys.Rev.C **104**, 034301 (2021).

*Electronic address: siwach1@llnl.gov