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Toward simulating the nuclear shell model in a quantum computer

Content

The nuclear shell model is one of the prime many-body methods to study the structure of atomic nuclei, but it is hampered by an exponential scaling on the basis size as the number of particles increases. As a possible avenue to overcome this limitation, I will discuss how to implement shell-model calculations using a digital quantum computer. In particular, I will focus on how to solve nuclear ground states using variational quantum eigensolver algorithms, building circuits in a quantum device to encode the shell-model states. I will also discuss two possible methods to find the ground state: unitary coupled cluster, and ADAPT, and discuss their suitability across the nuclear chart.

In addition, I will also introduce how information theory concepts, such as entanglement, can provide insights on nuclear structure, and how to take advantage of this for improving shell-model calculations using classical and quantum devices.

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