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Quantum Numerical Integration Algorithm of a Polynomial Function for Nuclear Structure Application

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Quantum computers have also shown potential for efficient Hamiltonian simulation where computational resources scaling polynomially with system size. For instance, the Variational Quantum Eigensolver (VQE) has been adapted to evaluate ground state energy of nuclei [1] and the hardware specification needed [2], and to solve Bardeen-Cooper-Schrieffer (BCS) Hamiltonian [3]. In this project, we aim to
utilize the quantum computer to solve a nuclear structure related numerical integration problem. Quantum numerical integration algorithms (QNIA) have been shown to offer quadratic speedup over classical counterparts [4]. While QNIAs have found applications in finance and high-energy physics, these implementations used gate counts that exceed the capabilities of near-term quantum hardware [5]. Newer integration algorithms such as Fourier Quantum Monte Carlo Integration [6] and General Quantum Integration Algorithm (GQIA) [7] has been proposed. This presentation will discuss on the test outcomes of quantum integration on a simulated quantum computer using Qiskit provided by IBM.

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