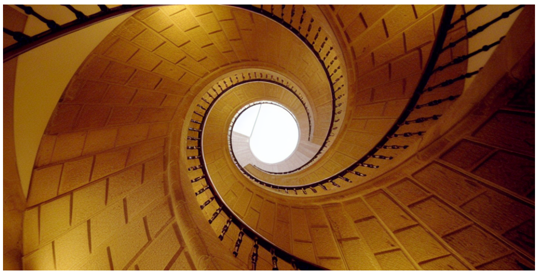

Contribution ID: **23** Type: **Talk**

Digitized Counter-Diabatic Quantum Algorithms

Wednesday, May 31, 2023 10:20 AM (30 minutes)

Shortcuts to adiabaticity [1] are well-known methods for controlling the quantum dynamics beyond the adiabatic criteria, where counter-diabatic (CD) driving provides a promising means to speed up quantum many-body systems. In this talk, we show the applicability of CD driving to enhance the digitized adiabatic quantum computing paradigm in terms of fidelity and total simulation time. Firstly, we begin with the state evolution of an Ising spin chain using the digitized CD driving derived from the variational approach [2]. We apply this technique in the preparation of Bell and Greenberger-Horne-Zeilinger states with high fidelity using a very shallow quantum circuit, demonstrating the acceleration of adiabatic quantum computing in noisy intermediate-scale quantum devices. Secondly, we focus on quantum approximate optimization algorithm (QAOA), an effective classical-quantum algorithm serving multiple purposes, from solving combinatorial optimization problems to finding the ground state of many-body quantum systems. Since QAOA is an ansatz-dependent algorithm, there is always a need to design ansatz for better optimization. To this end, we propose a digitized version of QAOA enhanced via the use of shortcuts to adiabaticity [3]. Specifically, we use a CD driving term to design a better ansatz, along with the Hamiltonian and mixing terms, enhancing the global performance. We apply our digitized CD QAOA extensively to Ising models, classical optimization problems, and the P-spin model, demonstrating that it outperforms standard QAOA in all cases that we study. Finally, our talk will end up with different applications in quantum factorization [4], portfolio optimization [5], and protein folding [6]. It is concluded that the polynomial enhancement of digitized-counterdiabatic quantum optimization (DCQO) is accomplished by CD terms, severing as non-stoquastic catalyst [7].

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