Simulation of a Rohksar-Kivelson ladder on a NISQ device

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We present a quantum-classical algorithm to study the dynamics of the Rohksar-Kivelson plaquette ladder on NISQ devices. We show that complexity is largely reduced using gauge invariance, additional symmetries, and a crucial property associated to how plaquettes are blocked against ring-exchange in the ladder geometry. This allows for an efficient simulation of sizable plaquette ladders with a small number of qubits, well suited for the capabilities of present NISQ devices. We illustrate the procedure for ladders with simulation of up to 8 plaquettes in an IBM-Q machine, employing scaled quantum gates.

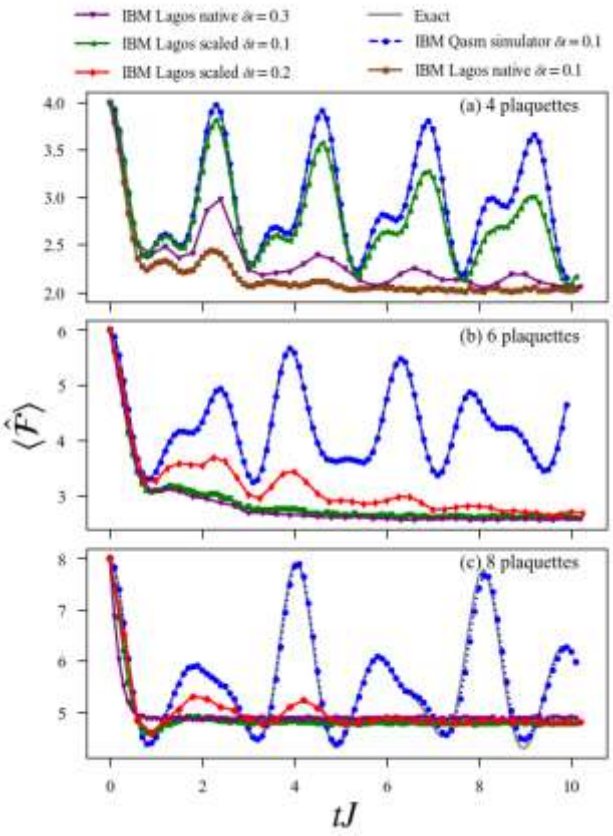

Figure 1: Average number of flippable plaquettes ⟨F⟩ as a function of time for an RK-ladder with λ = 1 and (a) 4 (b) 6 (c) 8 plaquettes. We compare the results obtained from exact time evolution, the ideal simulator, and the noisy circuit with non-scaled and scaled gates for different Trotter steps δt (see legend over Fig. (a))

References

[1] Sabhyata Gupta,Younes Javanmard, Tobias J. Osborne,Luis Santos, arXiv:2401.16326 [quant-ph],2024