

# Simplifying the simulation of local Hamiltonian dynamics

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Local Hamiltonians  $H_k$  describe non-trivial  $k$ -body interactions in quantum many-body systems. Here, we address the dynamical simulatability of a  $k$ -local Hamiltonian by a simpler one  $H_{k'}$  with  $k' < k$  under the realistic constraint that both Hamiltonians act on the same Hilbert space [1]. When it comes to exact simulation, we build upon known methods to derive examples of  $H_k$  and  $H_{k'}$  that simulate the same physics. Next, we address the most realistic case of approximate simulation. There, we upper-bound the error up to which a Hamiltonian can simulate another one, regardless of their internal structure, and prove, by means of an example, that the accuracy of a  $(k' = 2)$ -local Hamiltonian to simulate  $H_k$  with  $k > 2$  is likely to increase with  $k$ . Finally, we propose a numerical method to search for the  $k'$ -local Hamiltonian that simulates, with the highest possible precision, the short time dynamics of a given  $H_k$  Hamiltonian.

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## References

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- [1] A. Usui, A. Sanpera, M. García Díaz, arXiv:2310.07054.