Open Source Matrix Product States: A Simulation Platform for Quantum Computing Technologies

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WHAT IS IT?

OpenMPS is an open source simulation platform for studying a class of quantum systems pertinent to quantum computing technologies. With the ability to instantiate novel 1D systems with user-defined parameters, OpenMPS enables rapid prototypical analysis of a diverse range of systems. Given its Python front end, users can build their own Hamiltonians, and initialize their own states, making OpenMPS widely extensible and easy-to-use. Available at https://sourceforge.net/projects/openmps

TYPICAL WORKFLOW

From the provided examples
- Open one of the examples, and just run it
- Instantiate Operators, Hamiltonian, Observables, and the System
- Define Convergence Criteria and Evolution
- Run it, and visualize

From scratch
- Define Operators, Hamiltonian, Observables, and the System, then run it

OBJECTIVES
- To enable quantum computing technologies design
- Guide physical implementation of quantum simulators
- Trap ions, superconducting qubits, cold atoms in optical lattices, etc.
- Explore entangled dynamics of model Hamiltonians
- Resolve foundational issues in open quantum systems and quantum decoherence

Illustration of ultracold fermionic atoms in an optical lattice potential. Along the strong bonds of the lattice, antiferromagnetic (or anti-aligning) correlations form, detection of which has only now been achieved, allowing for a better understanding of the signature of quantum magnetism. Credit: Thomas Pfau / Phys. Zürich. https://phys.org/news/2013-03-quantum-simulator-magnetic-materials.html

TOOLBOX
- A model store for quick and easy deployment for virtual quantum systems.
- Enables education at all levels by building intuition
- Create and maintain a forum for theorists, experimentalists, educators, and citizen scientists to collaborate
- Enables education at all levels by building intuition
- Store your simulations, papers, and findings all in one place

Performance metrics in the loop
- Set of models defined by a community of experts
- Know how many resources are available right away
- Know how the simulation scales before you run it
- A model store for quick and easy deployment for virtual quantum systems.