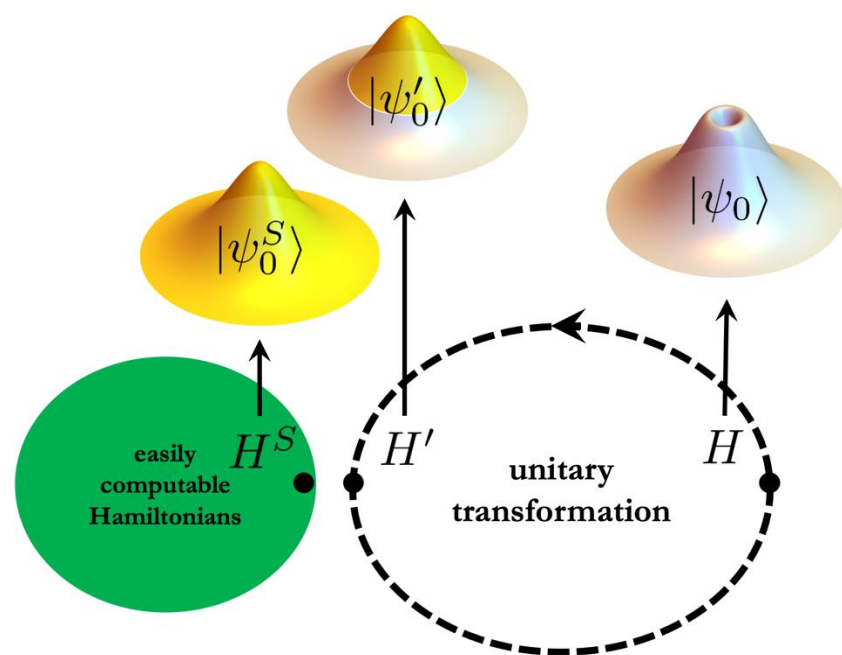


Wavefunction matching for solving quantum many-body problems

Objectives

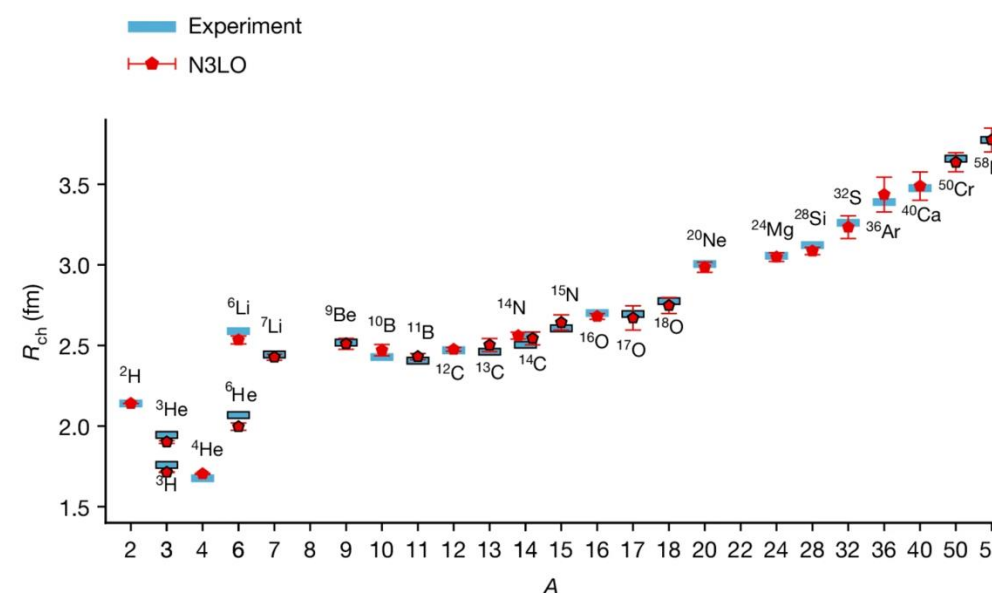
- Realistic high-fidelity interactions can cause severe computational problems when solving quantum many-body systems. Wavefunction matching solves this problem by transforming the interaction at short distances.
- The new interaction has low-energy wavefunctions that are close to those of an easily computable interaction. Calculations can therefore be performed using the easily computable interaction and applying perturbation theory.



Wavefunction matching replaces the short distance part of the two-body wavefunction for a realistic interaction with that of an easily computable interaction. The result is a new interaction that can then be handled in quantum many-body calculations.

Impact (as of now)

- Wavefunction matching is particularly useful for quantum Monte Carlo simulations. Calculations that were once impossible due to the Monte Carlo sign problem can now be performed using wavefunction matching.
- Wavefunction matching was successfully applied to lattice quantum Monte Carlo simulations for light nuclei, medium-mass nuclei, neutron matter, and nuclear matter using the chiral effective field theory.



Accomplishments (as of now)

- [“Wavefunction matching for solving quantum many-body problems”, Elhatisari *et al.*, Nature 603, 59-63 \(2024\).](#)
- [Physics World highlight](#)
- [FRIB highlight](#)
- [YouTube video](#)