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.

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