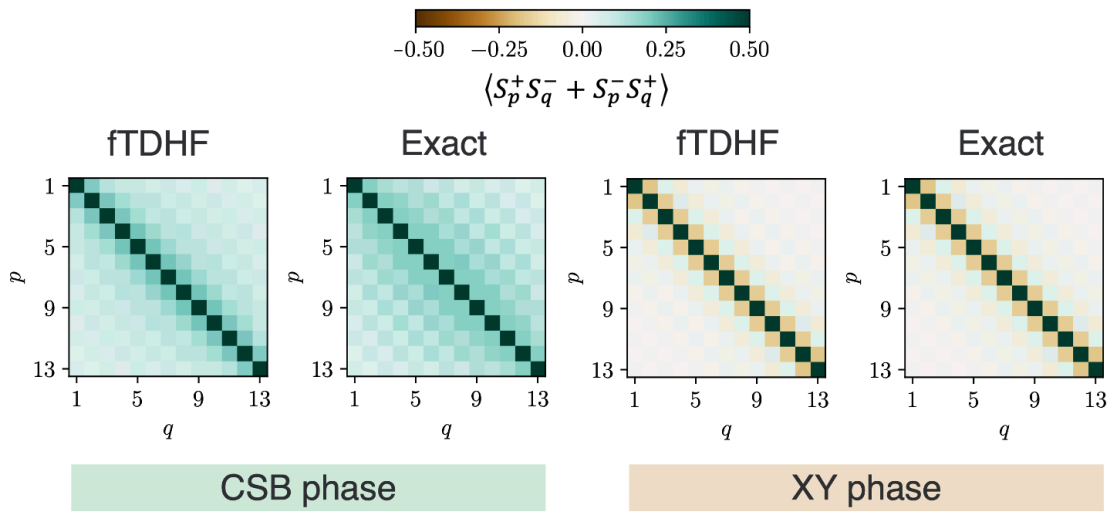
Mean-field Quantum Dynamics Beyond Free Fermions



Spin-spin correlation matrix elements of two states prepared in different spin phases (CSB left, and XY right) obtained using our method (fTDHF) and exact time evolution following an adiabatic ramp. This demonstrates that fTDHF captures the qualitative features of both phases.

Scientific Achievement

Introduced a mean-field real-time dynamics method for spin-1/2 systems via fermionization.

Significance and Impact

Enables efficient classical simulation of decaying long-range interacting spin systems relevant for condensed matter, high-energy physics and quantum simulation platforms.

Research Details

- The method maps spin-1/2 Hamiltonians to fermions via Jordan-Wigner transformation.
- The states are represented as single Slater determinants, evolving them under time-dependent Hartree-Fock, and Thouless rotations are used to handle the string operators exactly.

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- **NQISRC Intellectual Role:** *Collaborator*
- **NQISRC Funding Role:** *Majority*
- **Explanation of Funding Institution Contributions**
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