We apply a series of projection techniques on top of tensor networks to compute energies of ground state wave functions with higher accuracy than tensor networks alone with minimal additional cost. We consider both matrix product states as well as tree tensor networks in this work. Building on top of these approaches, we apply fixed-node quantum Monte Carlo, Lanczos steps, and exact projection. We demonstrate these improvements for the triangular lattice Heisenberg model, where we capture up to 57% of the remaining energy not captured by the tensor network alone. We conclude by discussing further ways to improve our approach.

**References**

5. The ITensor library is a freely available code developed and maintained on http://itensor.org/index.html.

**Test System**

• Heisenberg Model on a Triangular Lattice
• 10 x 10 lattice
• open boundary conditions

**Basis:** \{ |ψ⟩, H |ψ⟩, \ldots \}

**Solve:** \[ H |ψ⟩ = ES |ψ⟩ \] in this basis

**Ways to (exactly) compute basis**

- MPS/MPO Formalism
- Quantum Monte Carlo
- Hybrid QMC/MPO

**Way to (approximately) compute basis**

- Apply \[ H |ψ⟩ \] via MPO
- Truncate to smaller bond dimension \( b^2 \)
- Iterate

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