CIFellows 2020-2021

Computing Innovation Fellows

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SCAN ME

CAFQA: Clifford Ansatz For Quantum Accuracy

Quantum Computing

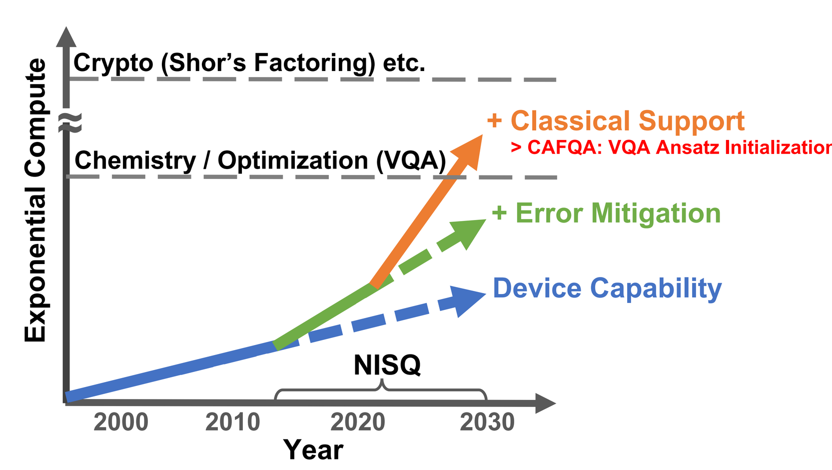
Why: Cryptography, chemistry, optimization, and machine learning.

How: Qubits redefine computation with interference, superposition, and entanglement.

When: Larger QCs + higher-fidelity qubits must emerge for quantum computing to be disruptive.

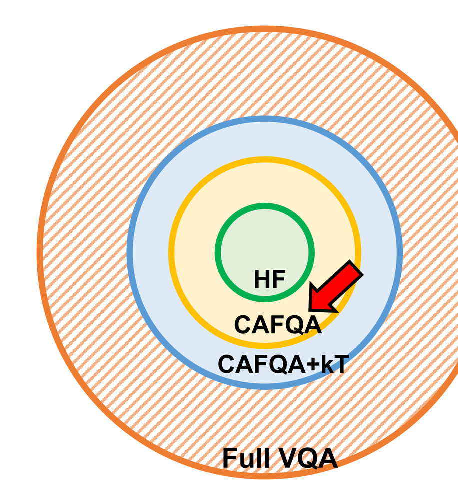
Classical Support for Quantum

Advancing NISQ frontiers with error mitigation and classical support.

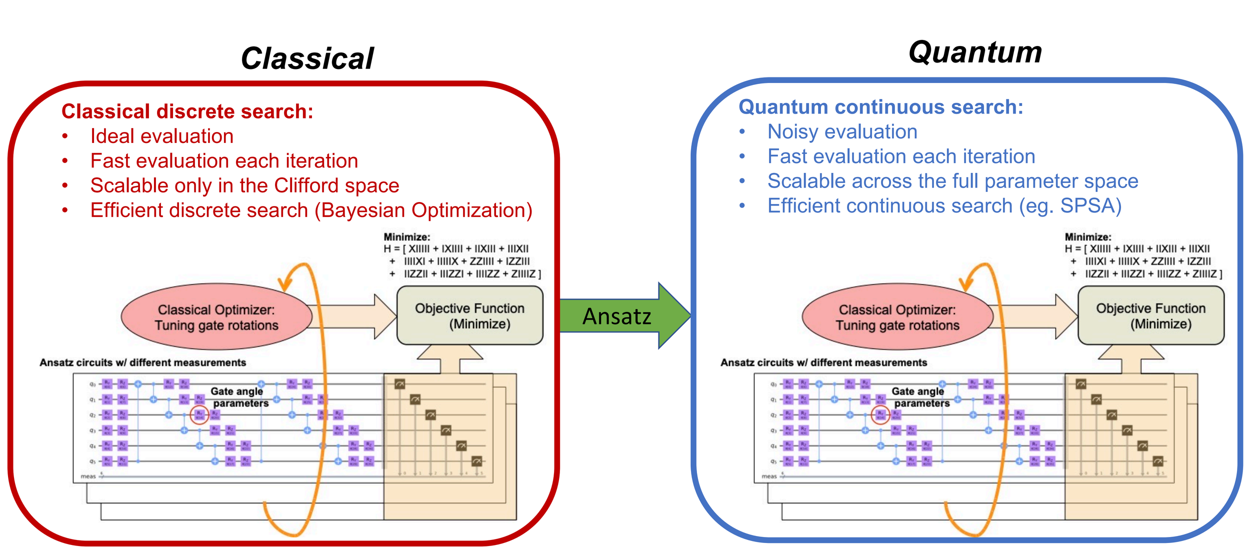


CAFQA Philosophy

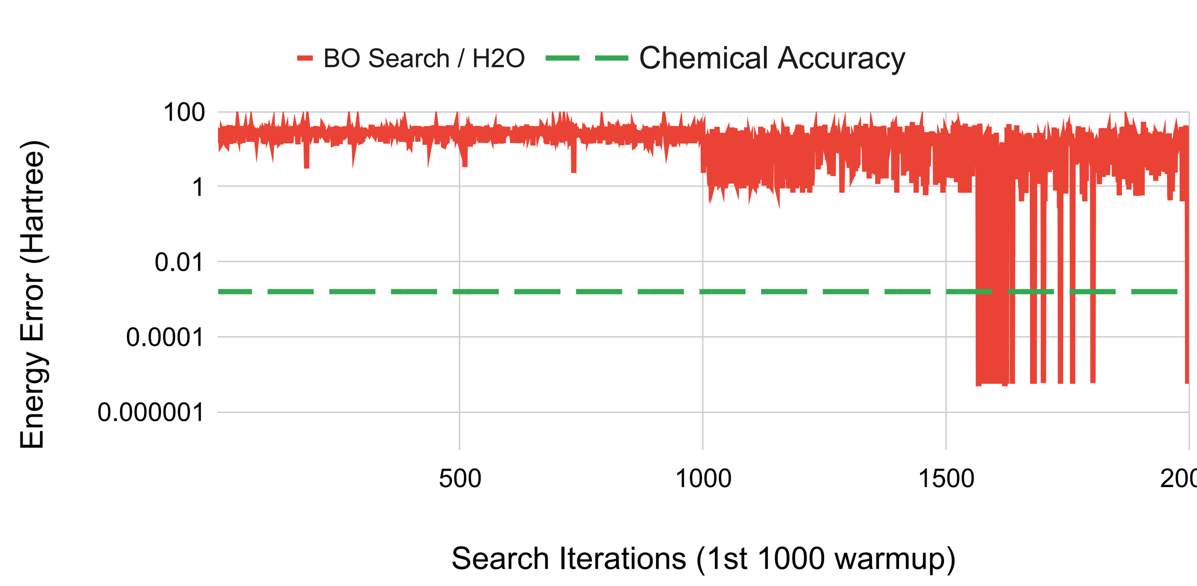
- NISQ machines are noisy, so VQA is inaccurate and slow to converge.
- Well chosen ansatz initialization can help VQA.
- Clifford initialization is promising because its simulation and search are classically efficient.
- Result:
  - ✓ CAFQA achieves 99% mean accuracy across VQE tasks.
  - ✓ Recovers up to 99.99% of correlation energy over Hartree-Fock.
  - ✓ Scalability tackles large complex systems like Chromium Dimer.
  - ✓ 2.5x faster convergence post initialization.



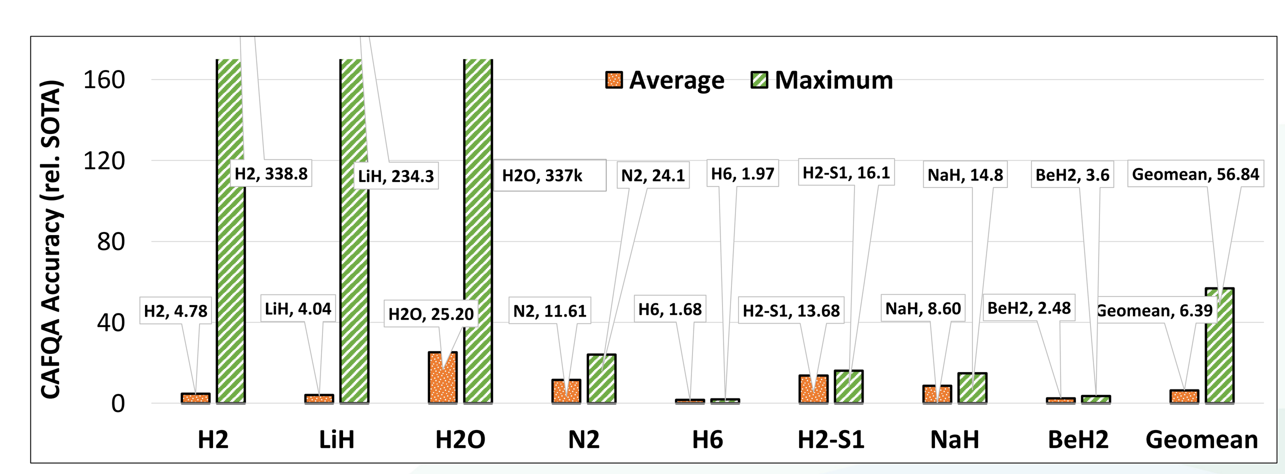
Design Overview



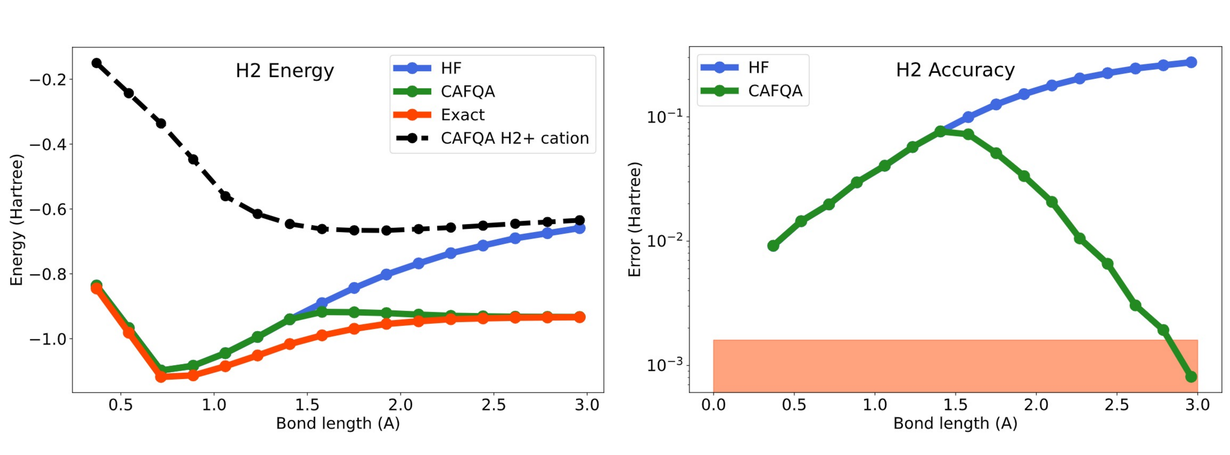
CAFQA at work



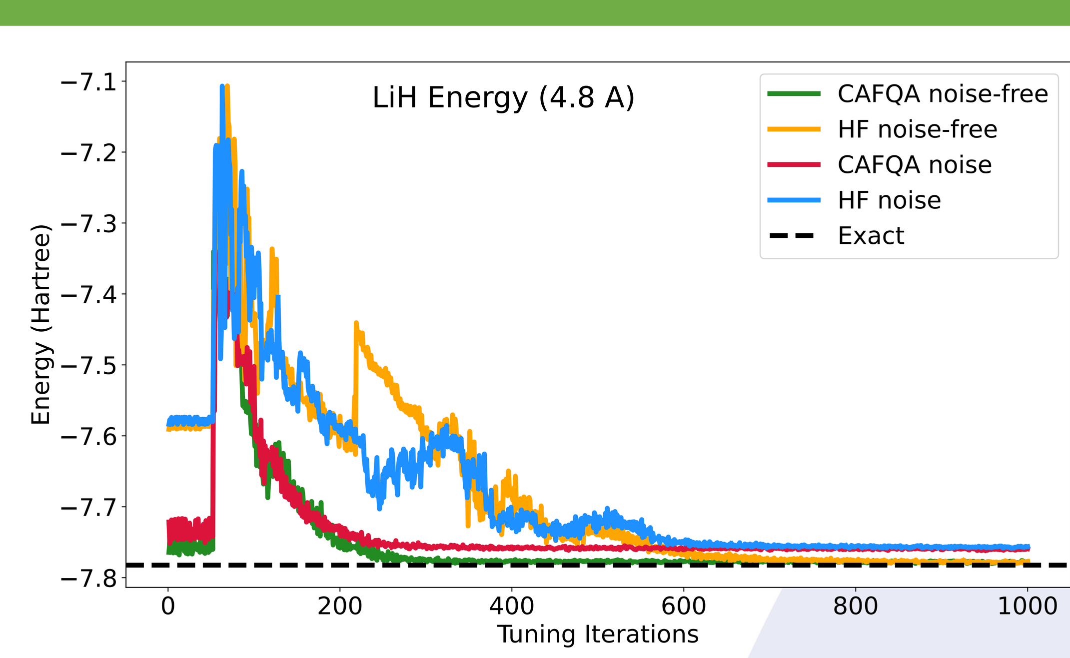
Overall accuracy benefits



H_2 Initialization: Accuracy!



Post-CAFQA tuning: Fast!



Ask me more

1. Extensions to CAFQA.
2. Error mitigation for variational quantum algorithms.
3. Leveraging diversity to improve NISQ-era fidelity.
4. Quantum resource management in the cloud.

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1: UChicago, 2: Super.tech, 3: MIT, 4: Tufts, 5: Duke

CRA Computing Research Association

CCC Computing Community Consortium Catalyst

NSF

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