VQompress

State Preparation via Quantum Compression
With applications to VQE

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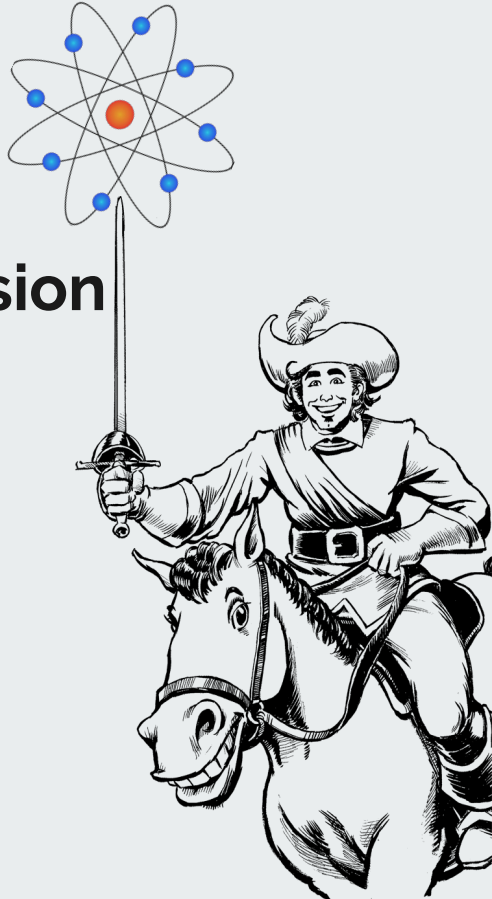
(The Three Qiskiteers)



Motivation

- NISQ computations are severely depth-limited
- In the absence of QRAM, state preparation circuits are expensive (in depth)

Can we reduce the cost of state preparation circuits?

Multi-Discriminant States (MDS) for VQE

1809.05523

Hartree-Fock States
(oversimplified)

$|111000\rangle$

$|100110\rangle$

$|001110\rangle$

Computational basis states corresponding to a discriminant of an electron configuration

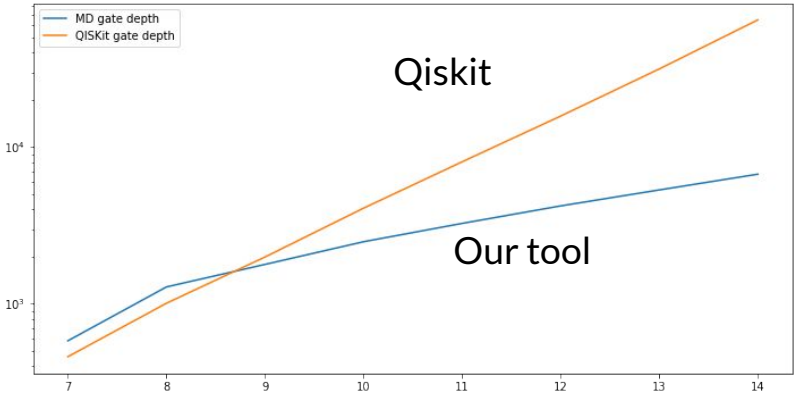
MDS States

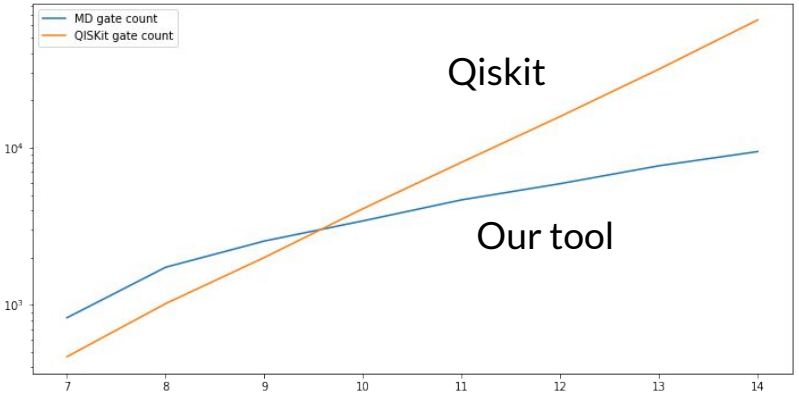
$0.19^*|111000\rangle$
$+ \quad 0.6\ ^*|100110\rangle$
$+ \quad 0.78\ |110010\rangle$

Real valued superposition over discriminants of an electron configuration

Gate count/depth comparison of Qiskit vs Our method for generating MDS States

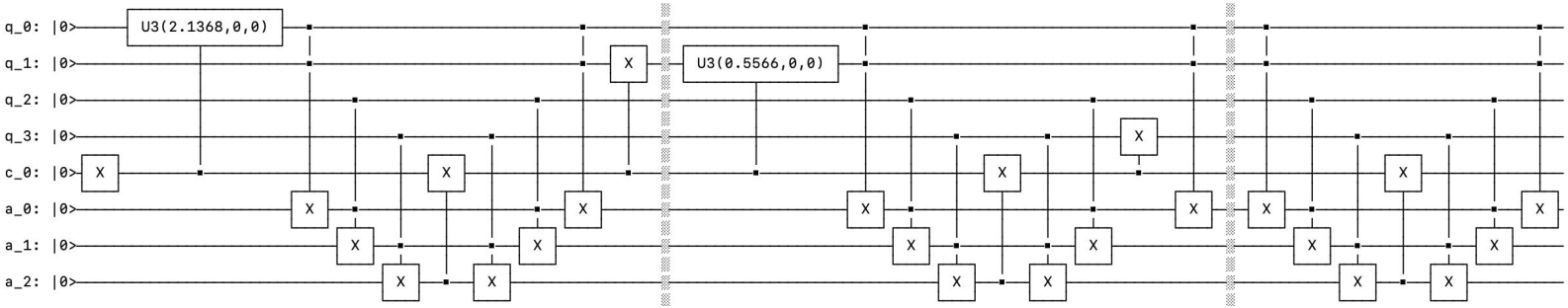
Y-axis in log scale

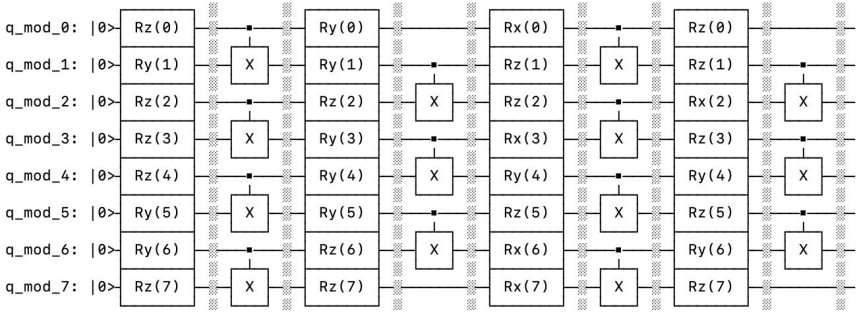




Number of Qubits composing MDS State

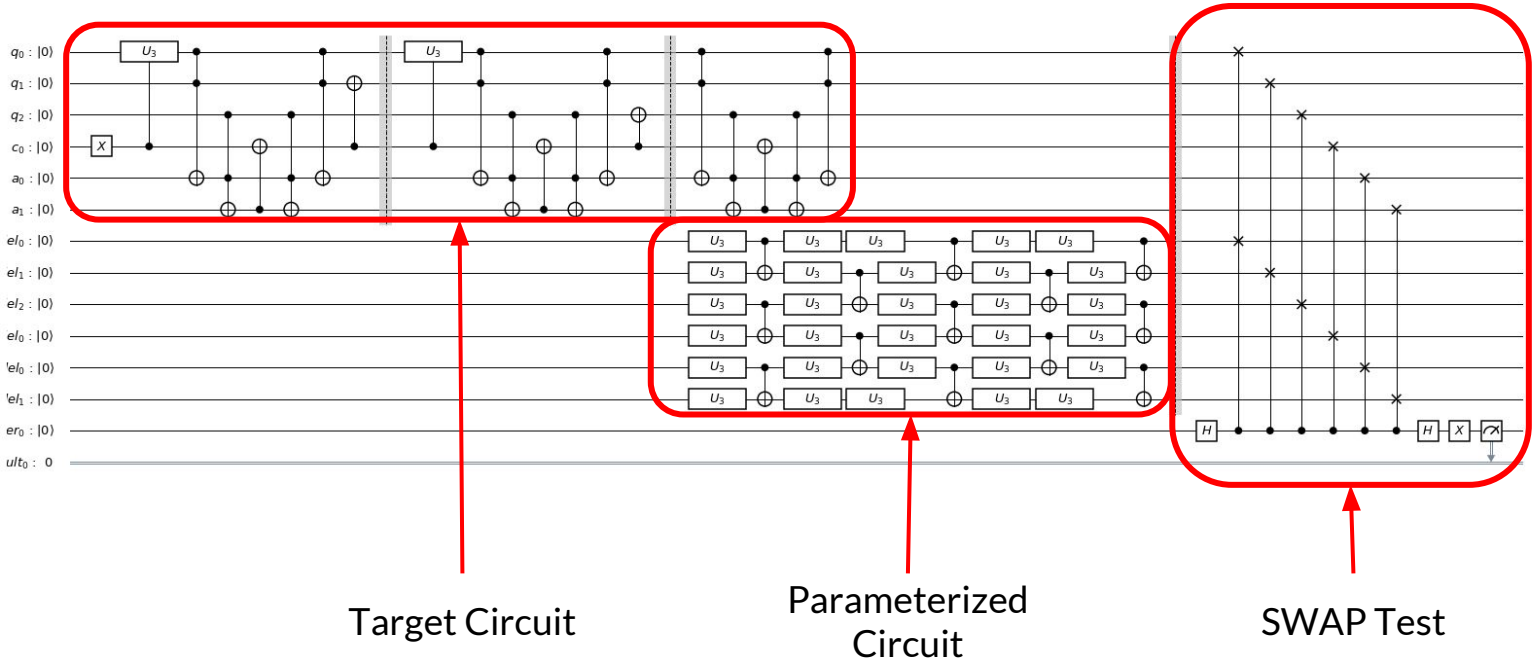
Quantum Compression via QNN's

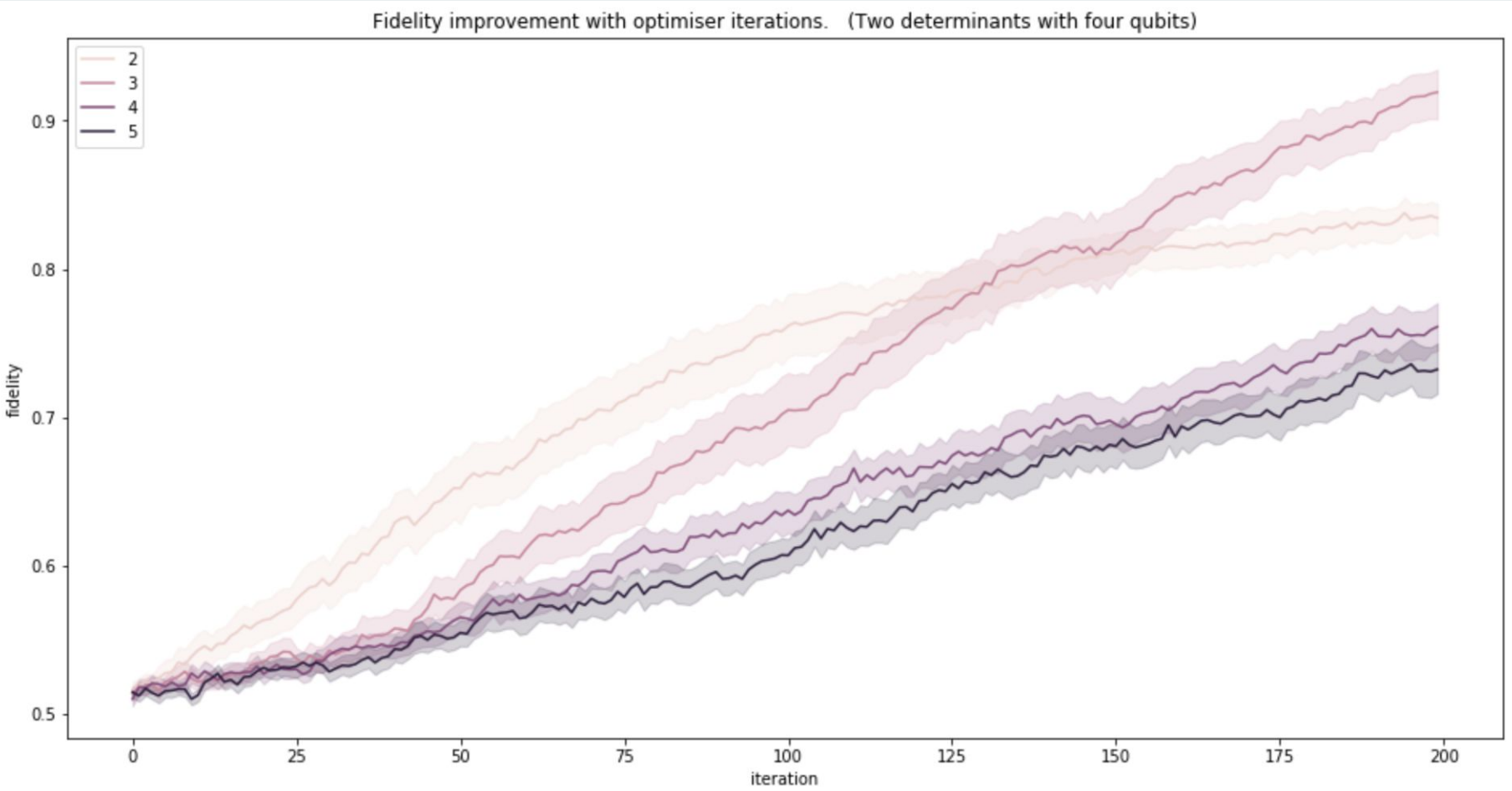


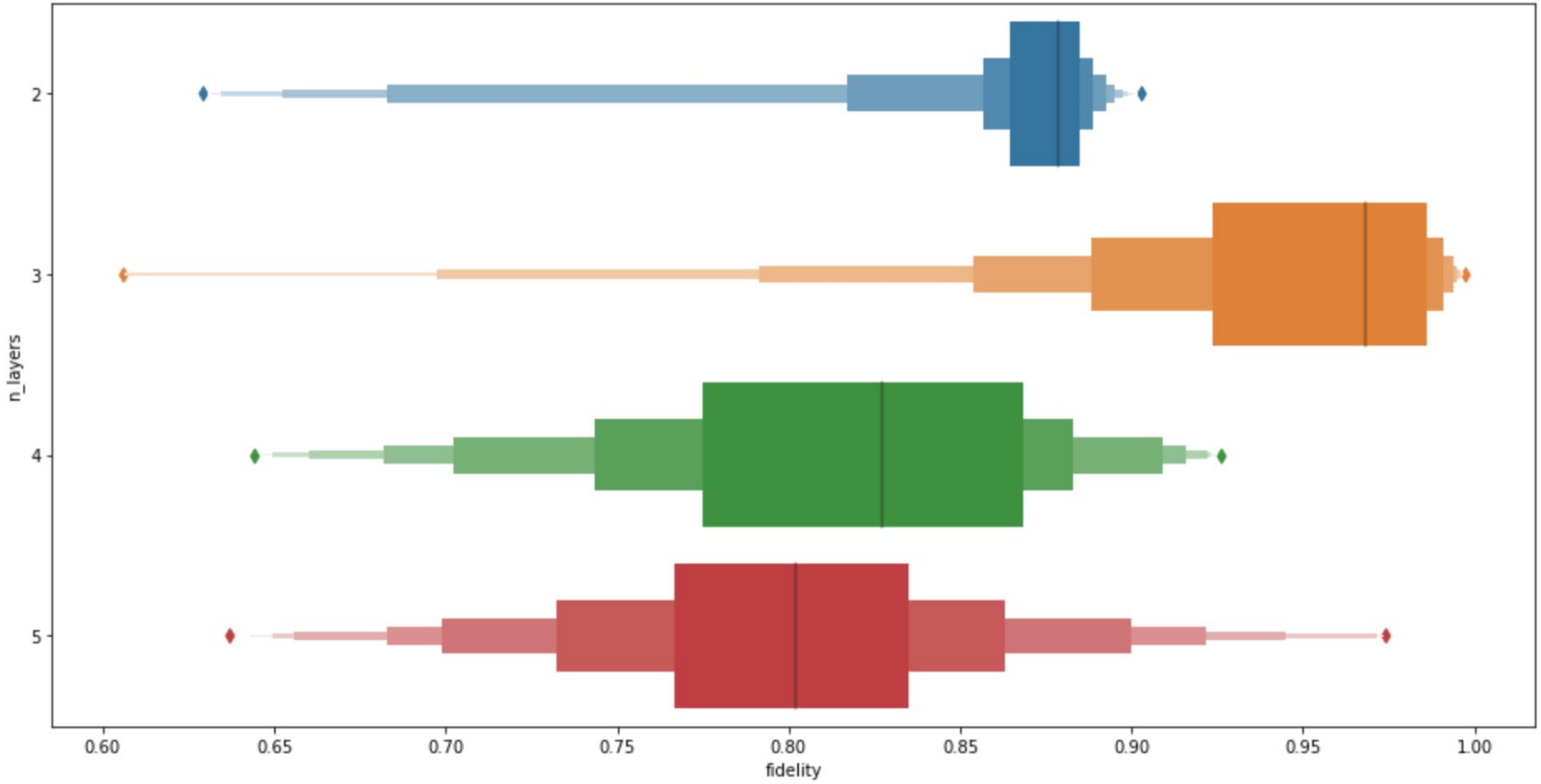


Quantum Compression Procedure (1 of 2)

- 2n+1 qubits required to learn n-qubit state




Fidelity improvement with optimiser iterations. (Two determinants with four qubits)
2
3
4
5
fidelity
0.5
0.6
0.7
0.8
0.9
0
25
50
75
100
125
150
175
200
iteration


n_layers
2
3
4
5
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
fidelity