# VQE2qubits_successful

May 1, 2026

[3]:
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import matplotlib.pyplot as plt
import numpy as np
from qiskit.circuit.library import TwoLocal
from qiskit.quantum_info import SparsePauliOp
from qiskit_algorithms import VQE
from qiskit_algorithms.optimizers import SLSQP
from qiskit.primitives import StatevectorEstimator as Estimator
from qiskit.circuit import QuantumCircuit

# 1. Define Hamiltonian (H = Z ^ Z)
hamiltonian = SparsePauliOp.from_list([("ZZ", 1.0)])

# 2. Define Initial State |11>
# We manually create the state preparation circuit
prep = QuantumCircuit(2)
prep.x([0, 1])

# 3. Define the Ansatz
# We use the class-based TwoLocal which is the most widely supported
ansatz = TwoLocal(num_qubits=2,
                  rotation_blocks='ry',
                  entanglement='cz',
                  reps=1,
                  initial_state=prep)

# 4. Setup Callback and VQE
counts, values = [], []
def callback(eval_count, parameters, mean, std):
    counts.append(eval_count)
    values.append(mean)

vqe = VQE(Estimator(), ansatz, SLSQP(maxiter=30), callback=callback)
result = vqe.compute_minimum_eigenvalue(hamiltonian)

# 5. Visualizations
print("Circuit Architecture (Decomposed):")
# Decomposing lets us see the X gates from the initial state
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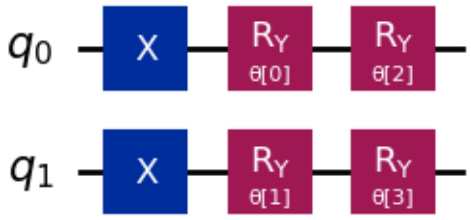
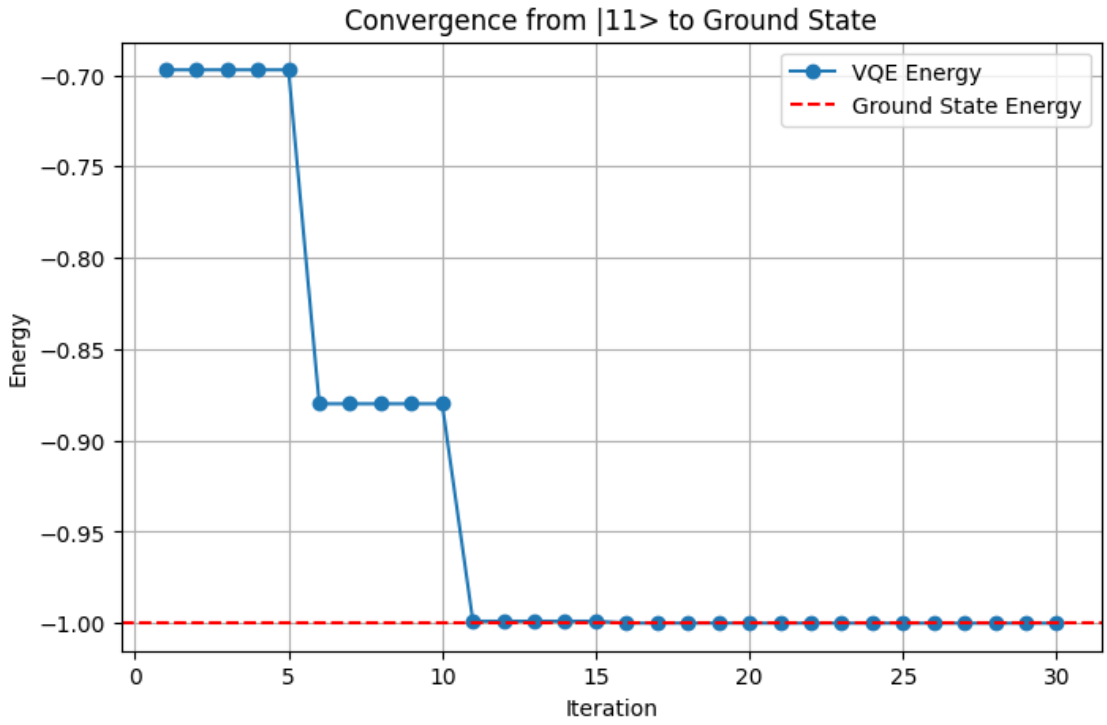
```
display(ansatz.decompose().draw('mpl'))

plt.figure(figsize=(8, 5))
plt.plot(counts, values, 'o-', label='VQE Energy')
plt.axhline(-1.0, color='red', linestyle='--', label='Ground State Energy')
plt.xlabel('Iteration')
plt.ylabel('Energy')
plt.title('Convergence from |11> to Ground State')
plt.legend()
plt.grid(True)
plt.show()

print(f"Convergence Target: -1.0")
print(f"VQE Final Result: {result.eigenvalue.real:.5f}")
```

```
/tmp/ipykernel_22726/3616643192.py:20: DeprecationWarning: The class
``qiskit.circuit.library.n_local.two_local.TwoLocal`` is deprecated as of Qiskit
2.1. It will be removed in Qiskit 3.0. Use the function
qiskit.circuit.library.n_local instead.
  ansatz = TwoLocal(num_qubits=2,
```

```
Circuit Architecture (Decomposed):
```






```
Convergence Target: -1.0
VQE Final Result: -1.00000
```

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