

An exercise in the previous lecture

We have a qubit Hamiltonian of the form

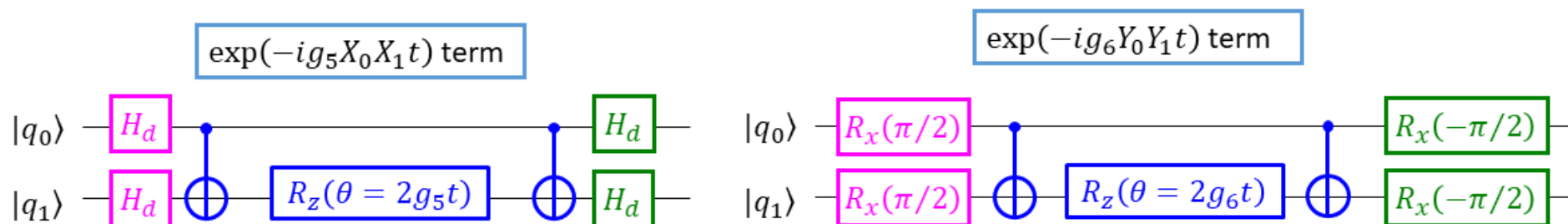
$$H = 0.5X_0X_1 + 0.5Y_0Y_1$$

1) Construct a quantum circuit on IBM-Q for the time evolution operator with $t = \pi$

$$U = \exp(-iHt) \approx \exp(-0.5iX_0X_1t) \times \exp(-0.5iY_0Y_1t)$$

2) Simulate the time evolution circuit with following conditions.

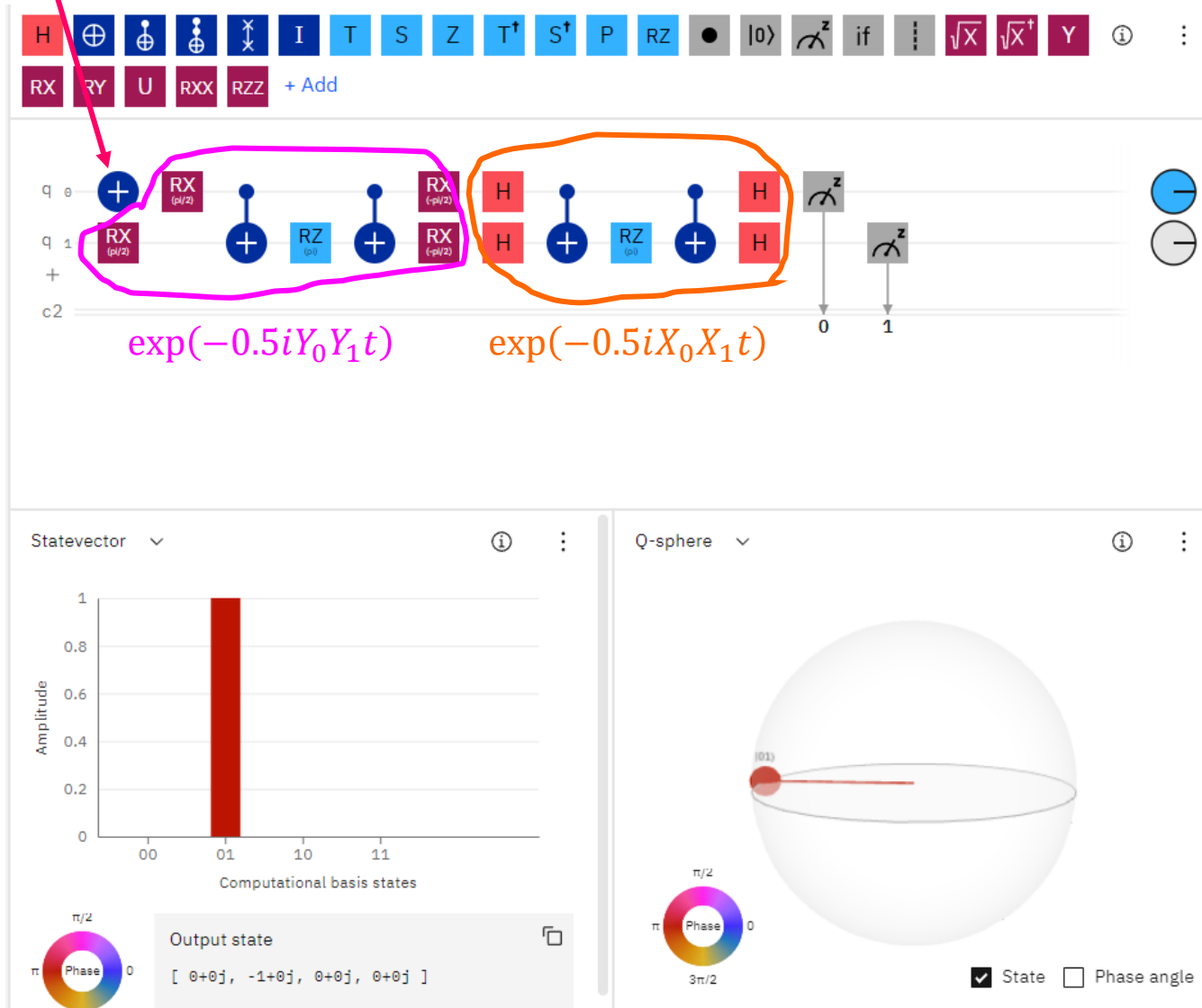
- Start from the $|10\rangle$ state by adding an X gate before the time evolution circuit
- Measure two qubits after time evolution
- Set evolution time $t = \pi/4, \pi/2, 3\pi/4$, and π
- Run the circuit on IBM-Q simulator_statevector and check the measurement outcome.
- Run the circuit on any IBM-Q machine (not simulators) and check the measurement outcome.



An exercise in the previous lecture

Pauli-X to generate $|10\rangle$

$$|\Psi(t)\rangle = \exp(-0.5iX_0X_1t) \exp(-0.5iY_0Y_1t) |10\rangle$$



OpenQASM 2.0

Open in Quantum Lab

```

1  OPENQASM 2.0;
2  include "qelib1.inc";
3
4  qreg q[2];
5  creg c[2];
6
7  x q[0];
8  rx(pi/2) q[1];
9  rx(pi/2) q[0];
10 cx q[0],q[1];
11 rz(pi) q[1];
12 cx q[0],q[1];
13 rx(-pi/2) q[0];
14 rx(-pi/2) q[1];
15 h q[1];
16 h q[0];
17 cx q[0],q[1];
18 rz(pi) q[1];
19 cx q[0],q[1];
20 h q[0];
21 h q[1];
22 measure q[0] -> c[0];
23 measure q[1] -> c[1];
    
```

Rotational angle corresponding to t

An exercise in the previous lecture

$$H = (a_0^\dagger a_1 + a_1^\dagger a_0) \xrightarrow{\text{JWT}} H = 0.5X_0X_1 + 0.5Y_0Y_1$$

