5.1 Neutral-atom Quantum Computing (Session: July 10) results for Mirza Akbar Ali

ⓘ Correct answers are hidden.

Score for this attempt: **10** out of 10 *
Submitted 14 Jul at 13:43
This attempt took 2 minutes.

Question 1

1 / 1 pts

[DiVincenzo criteria: well characterized qubit]

How is quantum information encoded in a neutral-atom qubit, i.e. what constitutes the two-level system with defined states $|0\rangle$ and $|1\rangle$?

- Ionizing the atoms, considering neutral and ionized
- Rotational Symmetry
- Motion excitation of the atoms
- ◉ Internal energy state of the atoms

Question 2

1 / 1 pts

[DiVincenzo criteria: initialize qubit]

How to initialize the neutral-atom qubit?

- ◉ Using lasers to drive the atom to the desired initial state
- Using magnetic fields to create degeneracy between states
- Let the system naturally evolve until it reaches the ground state

- Using light assisted collisions

Question 3

1 / 1 pts

[DiVincenzo criteria: long relevant decoherence time]

How can we improve the coherence time of neutral-atom qubits?

- Using light assisted collisions
- Let the system naturally evolve until it reaches the ground state
- Using magnetic fields to create degeneracy between states
- Reducing external sources of noise, for example, laser phase noise

Question 4

1 / 1 pts

[DiVincenzo criteria: universal set of gates – single qubit gates]

How can we implement gates using neutral-atom qubits? (Hint: in classical computing we switch between 0 and 1 in a controlled way)

- Rotating the atoms in well defined orientations
- Heating the atoms to higher motional states
- Exciting the atoms from one internal energy state to another
- Change the orientation of the magnetic field, i.e. quantization axis

Question 5

1 / 1 pts

[DiVincenzo criteria: universal set of gates – two qubit gates, entanglement]

Which fundamental atomic interaction is used to implement two qubit gates for neutral-atom quantum computing?

- Stark effect between atoms and light fields
- (•) Dipole-Dipole interaction between Rydberg atoms
- Coulomb interaction
- Zeeman effect between atoms and magnetic fields

Question 6

1 / 1 pts

[DiVincenzo criteria: qubit-specific measurement capability]

How do we differentiate between the qubit states for measurement?

- (•) Detecting light emitted from the atoms when probed with a laser beam
- Detecting excitations generated around the atom, called pollutants
- Measuring the magnitude of the electric field in the ensemble
- Measuring the temperature of the ensemble

Question 7

1 / 1 pts

[Errors]

What are the most common sources of errors in neutral-atom quantum computing?

- Dephasing of the Rydberg state
- All of the above
- State detection errors
- State preparation errors

Question 8

1 / 1 pts

[Hardware specific]

What is a unique feature of quantum computers based on cold atoms?

- They require the least maintenance compared to other platforms
- They can perform digital and analog quantum computing
- They can perform better than ions due to long life-times
- They are easier to operate and don’t require specialist knowledge

Question 9

1 / 1 pts

[Hardware specific]

What are the main limitations in scaling neutral-atom quantum computers?

- Laser power and uniform atomic array generation for large devices

- The millikelvin temperature needed requires large dilution fridges
- All of the above
- They require strong magnetic fields, which make then the most energy hungry of all platforms

Question 10

Not yet graded / 0 pts

[Comparison]

State an advantage and a disadvantage of neutral atoms as a quantum computing platform.

Your answer:

Advantage: Nature provides that all the qubits are strictly identical when taken independently, as opposed to artificial atoms such as superconducting circuits or Silicon spin qubits that need to be manufactured with as little heterogeneity as possible. This feature is a remarkable advantage for neutral atom quantum processors to achieve low error rates during the computation.
Disadvantage: Achieving ultra-low temperatures for this purpose is energy costly process. The drawback is that we cannot yet do neutral atom quantum computing at room temperature.

Question 11

1 / 1 pts

I confirm that I answered all questions, including stating an advantage and disadvantage of neutral atoms.

- (•) True
- ( ) False

Quiz score: **10** out of 10