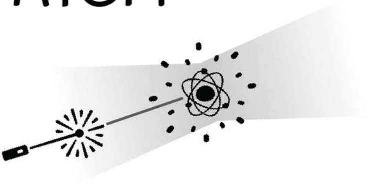
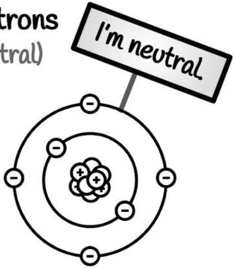
NEUTRAL ATOM



QUANTUM COMPUTERS

NEUTRAL ATOMS

- Have equal numbers of protons & electrons (electrically neutral)



- Can be in different energy states

$|0\rangle$ 

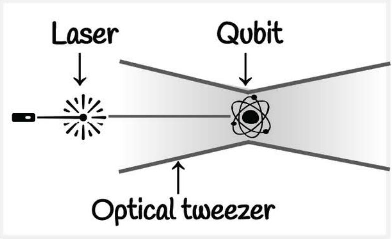
$|1\rangle$ 

"TRAPPING" QUBITS

To be useful as a qubit, a single atom must be caught and held in place.

To do this:

- lasers cool & slow the atoms
- optical tweezers hold them in place



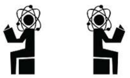
QUANTUM GATES

Single qubit gates

Lasers and microwaves are used to change the energy state of a qubit.

Multi-qubit gates are tricky!

Normally, neutral atoms do not interact with one another when spaced apart.



Non-Rydberg State

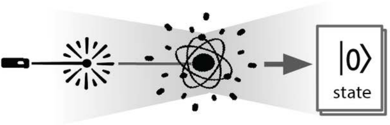
Rydberg State

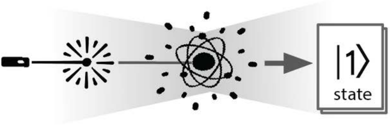
Exciting a qubit to a high-energy "Rydberg state" allows the qubit to interact with (affect the state of) a nearby qubit

MEASUREMENT

Qubits are measured with lasers

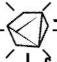
- Qubits in the 0 state emit light
- Qubits in the 1 state do not





ADVANTAGES

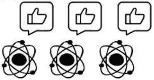
1. Stable!



Able to hold a quantum state for a relatively long period of time

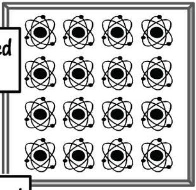
2. No manufacturing errors

Naturally occurring – each qubit is the same



3. Good connectivity

Can be organized into 2D grid

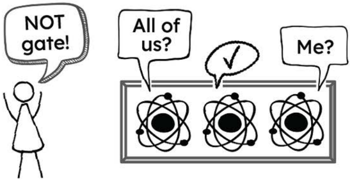


4. Highly Scalable

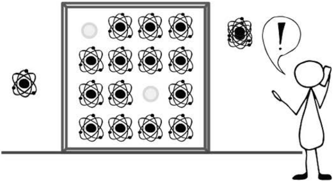
Can be densely packed and individually controlled

CHALLENGES

1. Individual qubits can be difficult to control



2. Atoms occasionally break free from trap



FIND MORE QUANTUM COMPUTING ZINES HERE:

https://www.epiqc.cs.uchicago.edu/resources/

MARCH 2023

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AN NSF EXPEDITION IN COMPUTING

EPiQC

https://www.epiqc.cs.uchicago.edu/