

Quantum computing with neutral atoms

by

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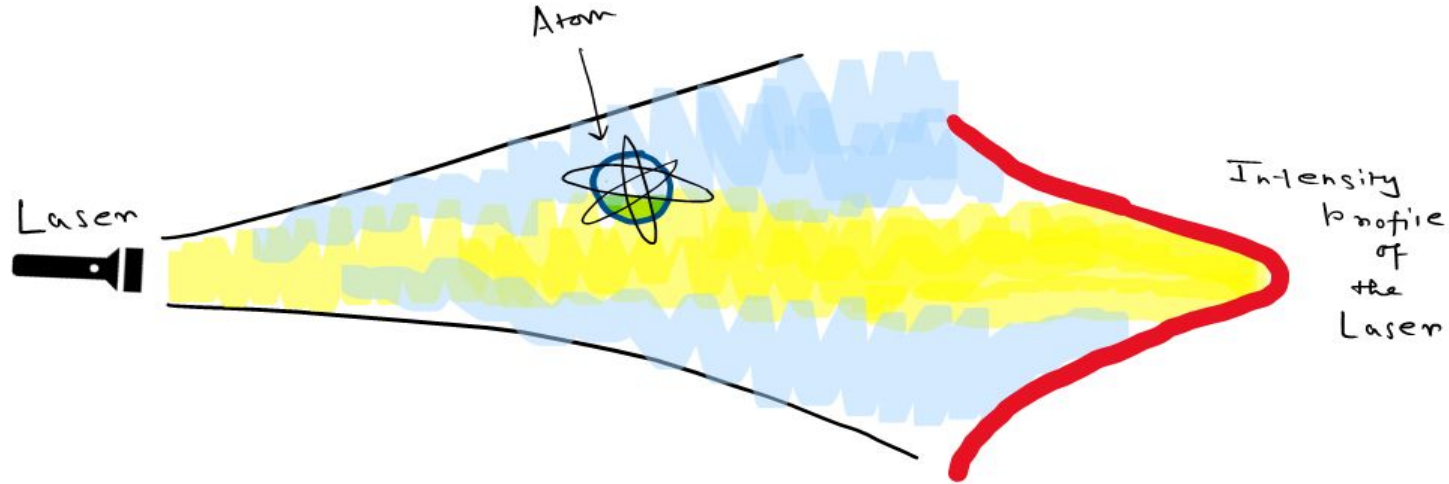


DiVincenzo criteria

1. Well characterized and scalable qubits.
2. Qubit initialization.
3. Long coherence time.
4. Universal set of gates.
5. Measurement of individual qubits.

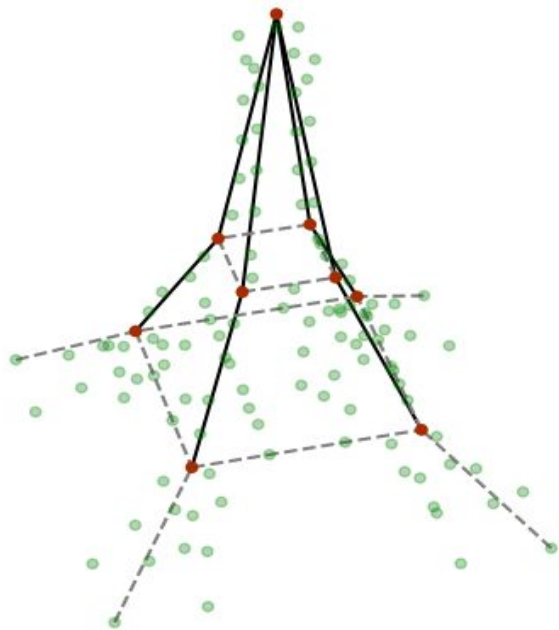
Characterization and scalability

Trapping individual Atoms:



Trapping individual atoms (contd..)

- **Optical tweezers.**
- Nearby qubits (neutral atoms) are able to interact via two-qubit gates.
- Quantum circuit topologies. [[Notebook](#)]
- Qubits too distant from each other can't be coupled with gates.
- Atoms within system's control radius interact with each other.



Data credit: [Pasqal](#)

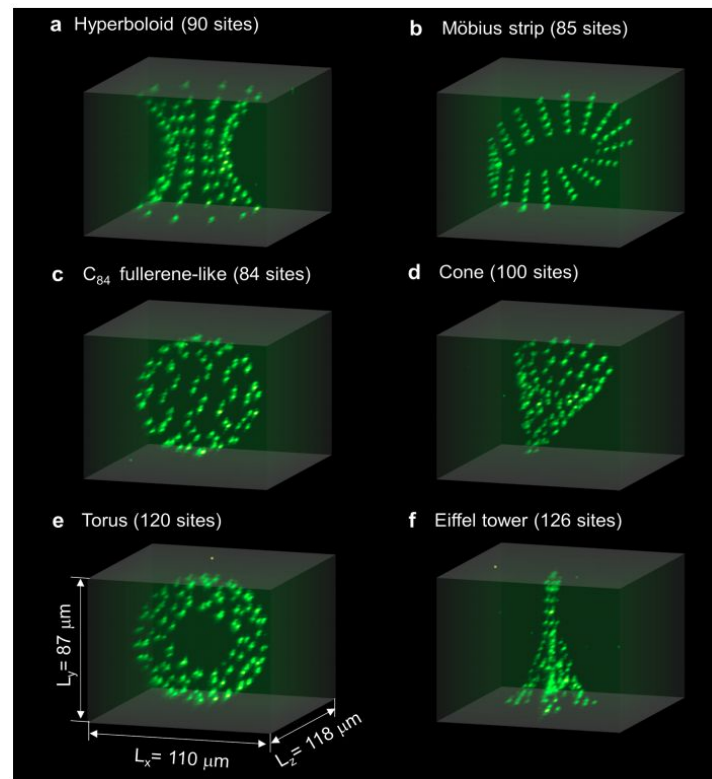


Image credit: [Barredo et al.](#)

Encoding a qubit

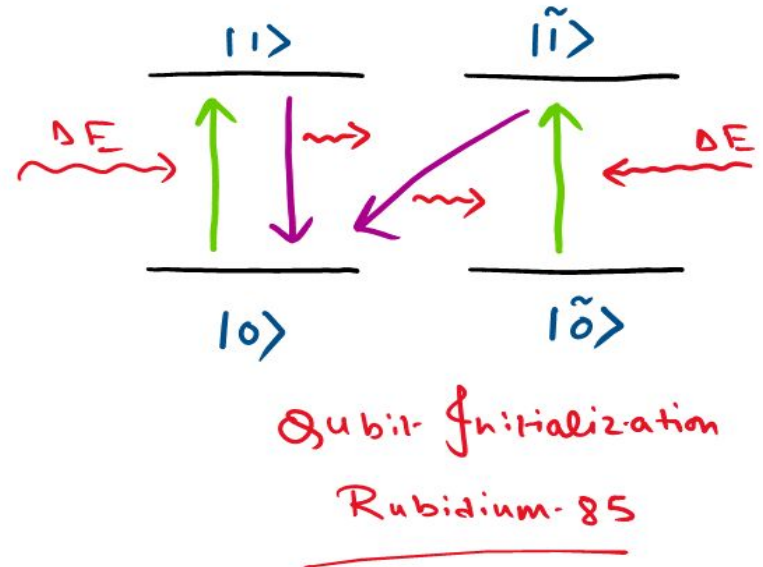
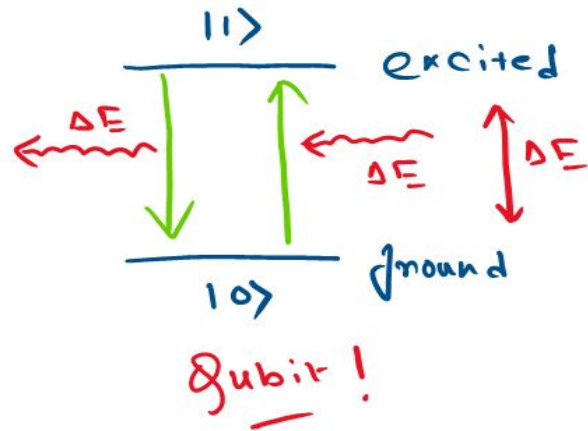
- We need only **one electron** to switch between two **distinct** energy states.
- Other electrons must not be affected.
 - Rubidium-85
- One **loose** electron.
- **One possible transition** from excited to ground state!

What guarantees only two states and not more?

Laser

More on encoding and Initialization

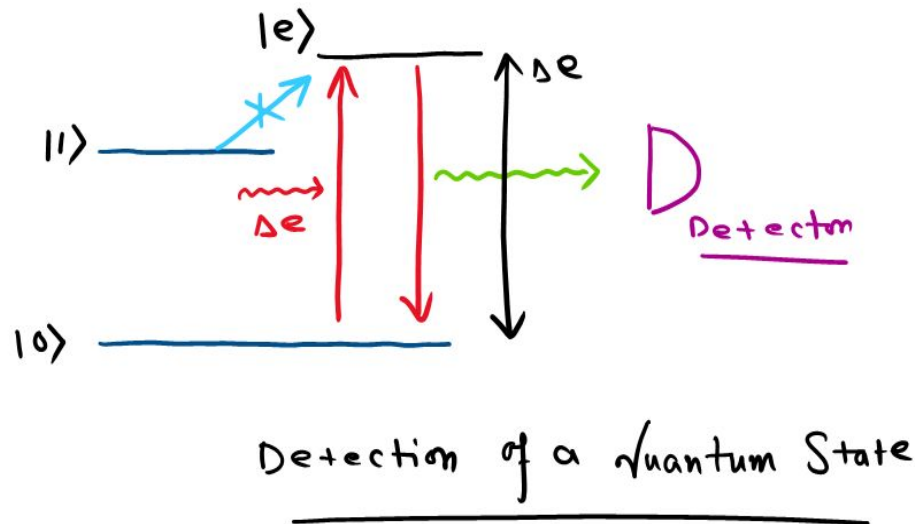
Laser cooling



Measurement

Fluorescence

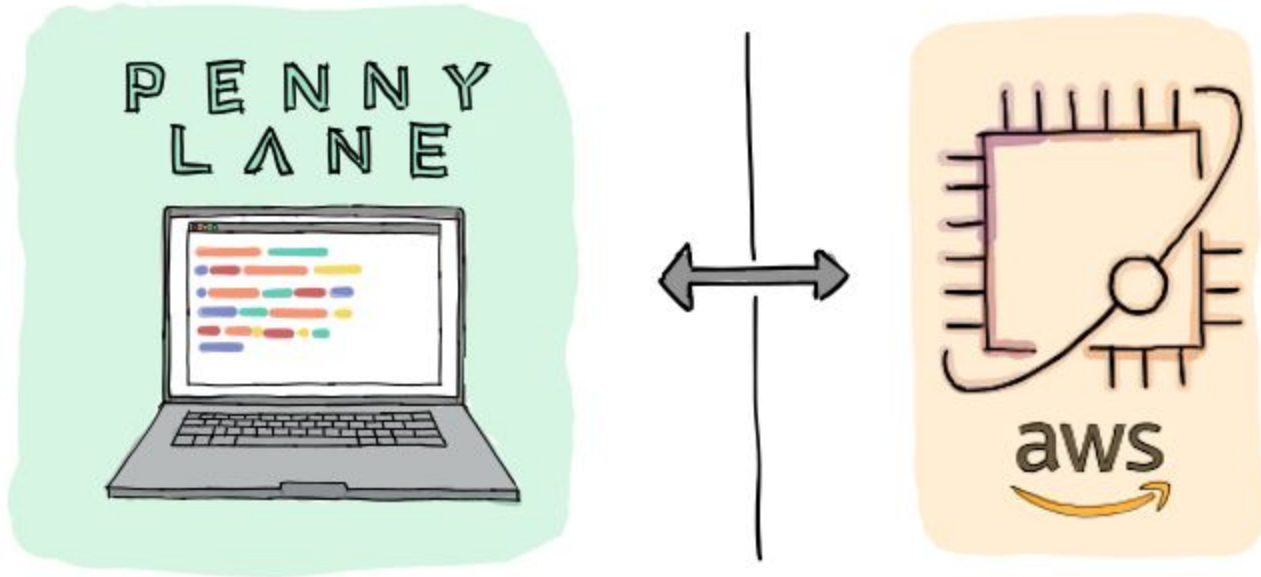
- About 2% optical tweezers remains empty (trapping failures).
- Not always initialization is correct.
- If the atom shines, the state is $|0\rangle$.



Aquila

Aquila: The 256 qubit wonder!

Aquila + Aws + Pennylane



Thanks