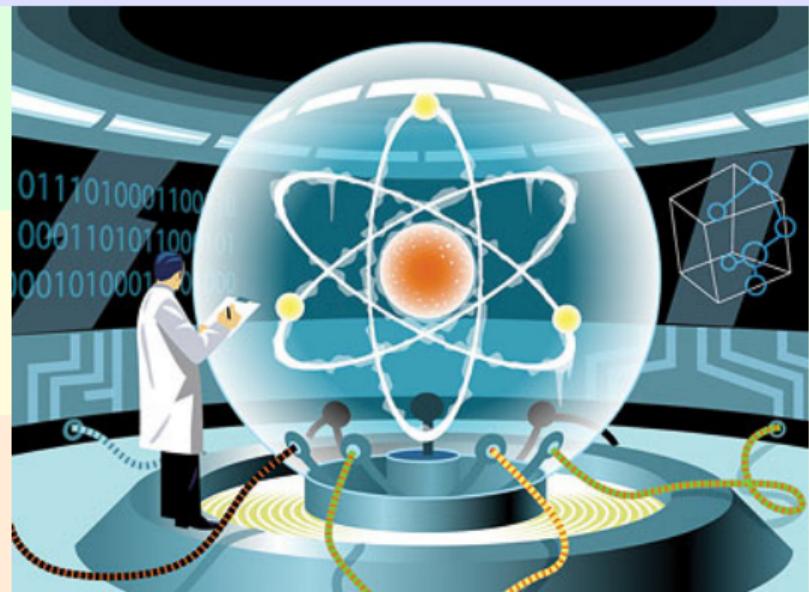


QUBIT.ZONE

QUANTUM COMPUTERS

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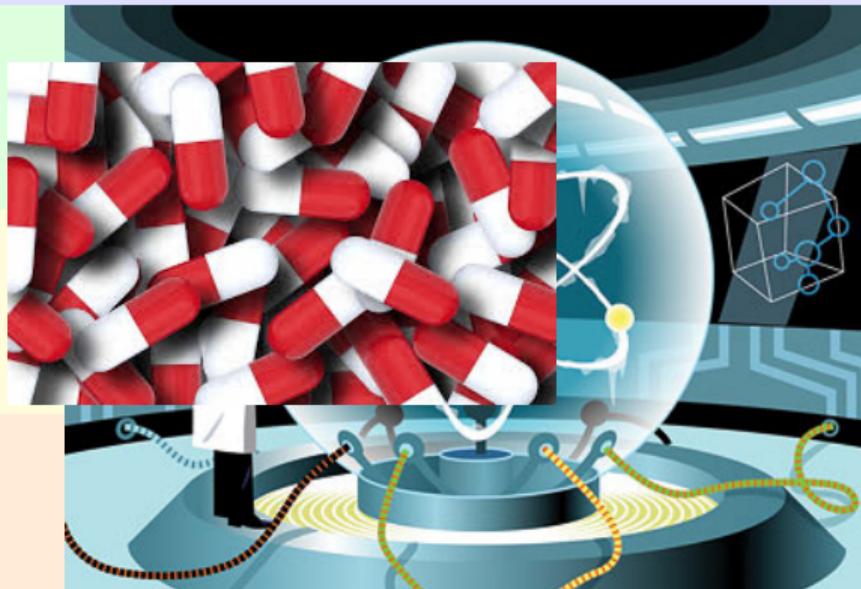


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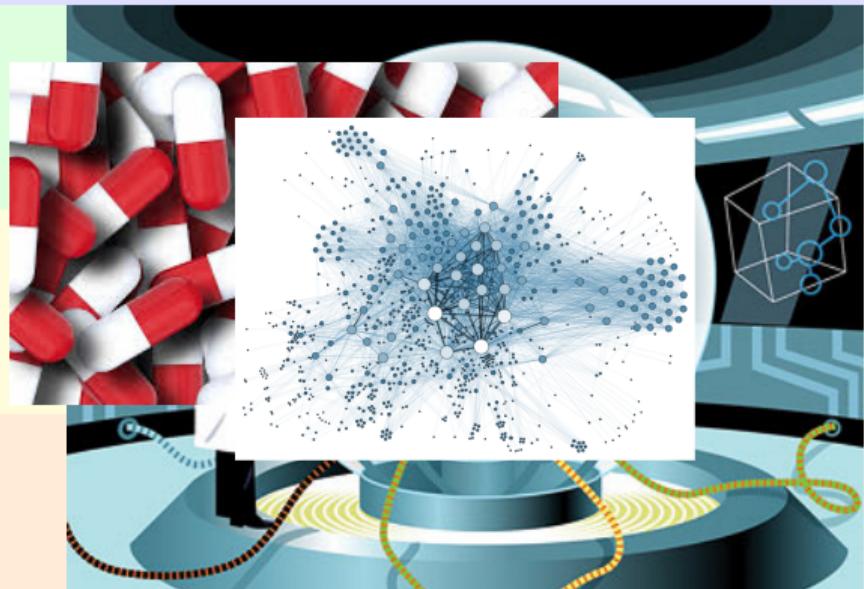


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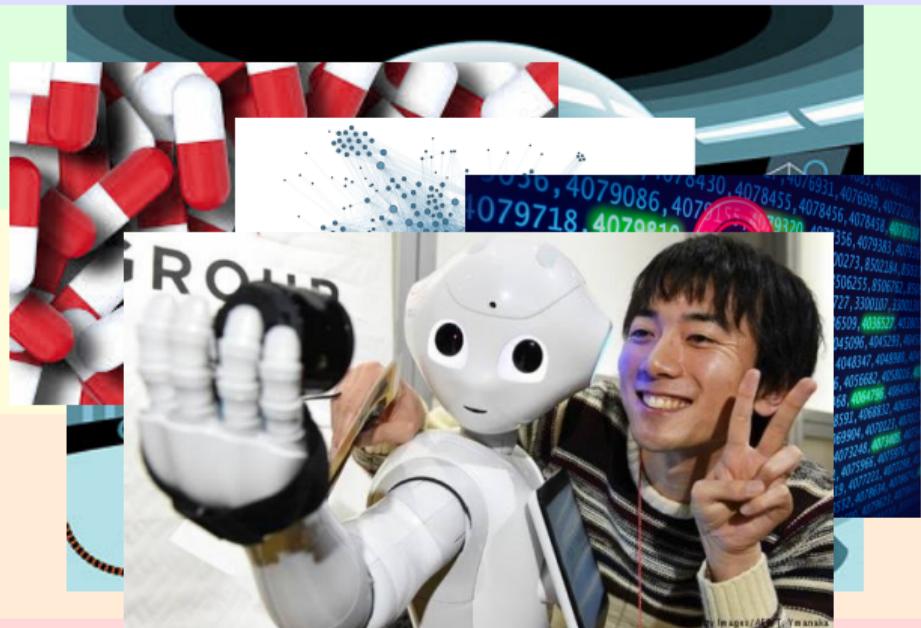


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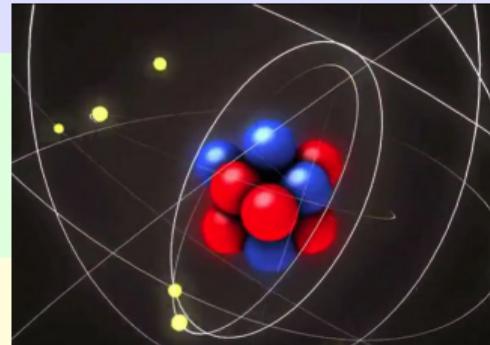
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But what *are* quantum computers?



THE QUANTUM WORLD

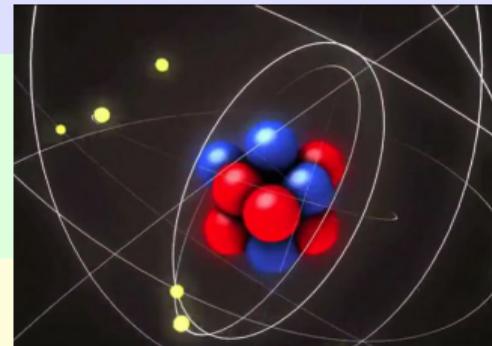
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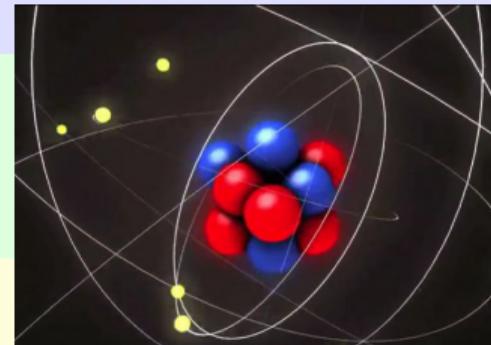
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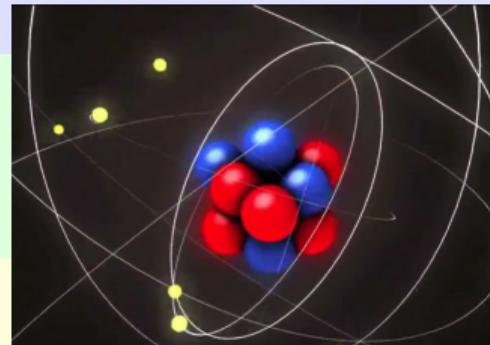


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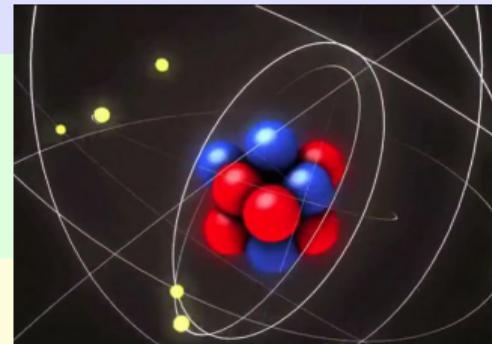
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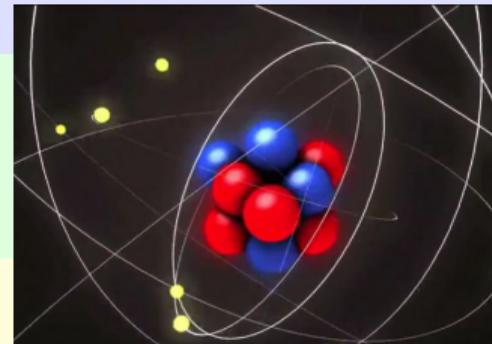
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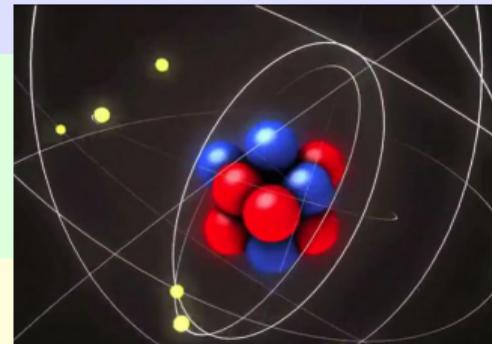
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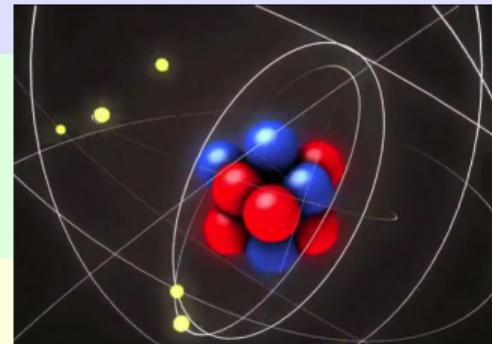
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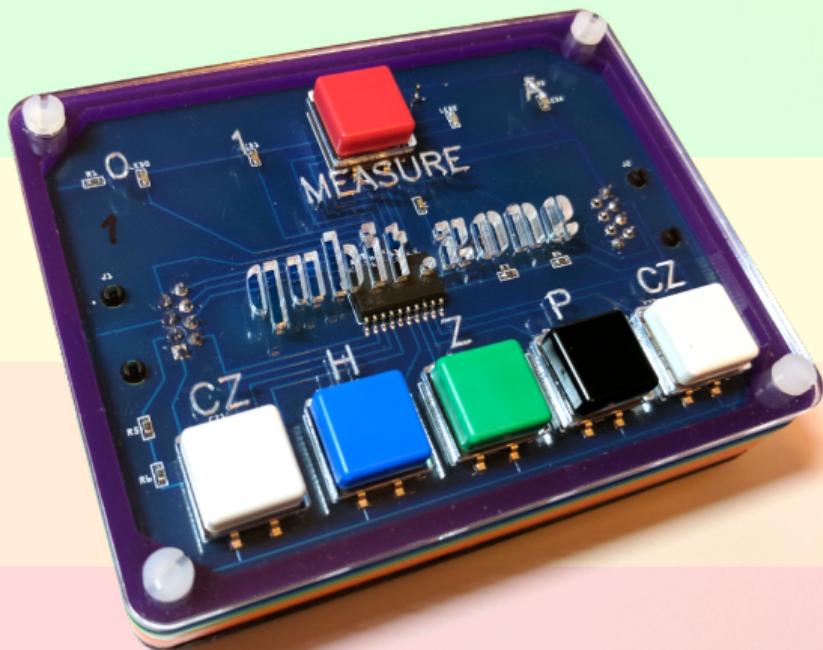
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Quantum computers will exploit these to perform their amazing tasks.

QUBITS

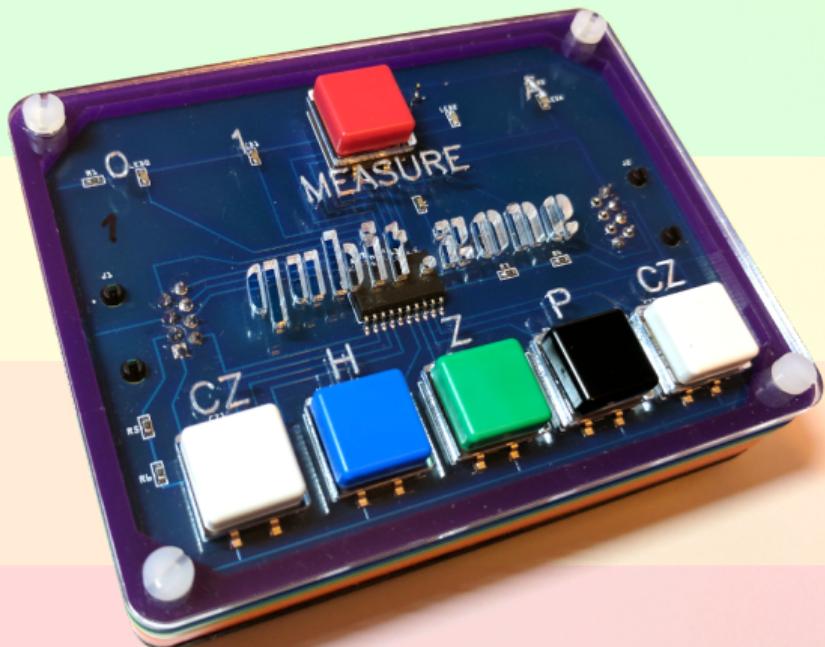
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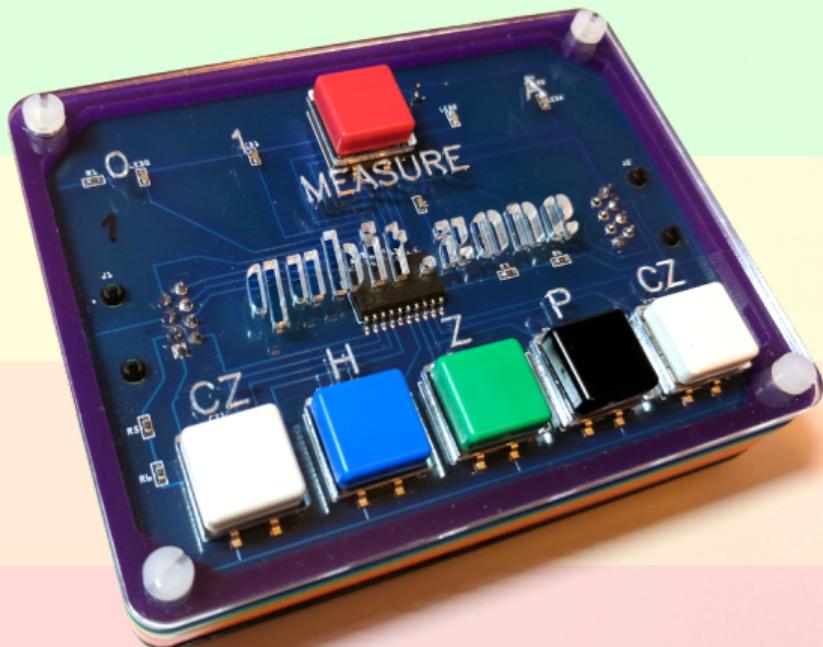
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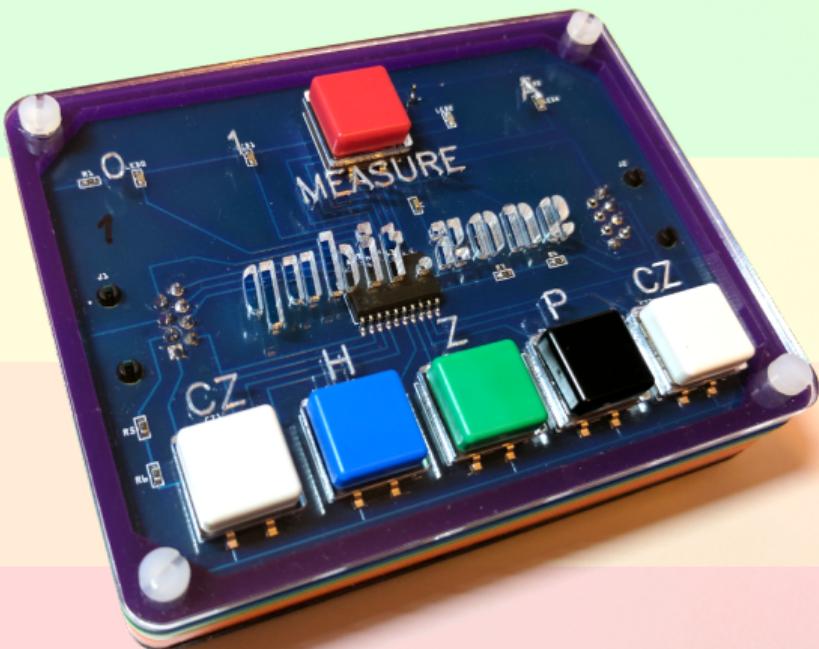
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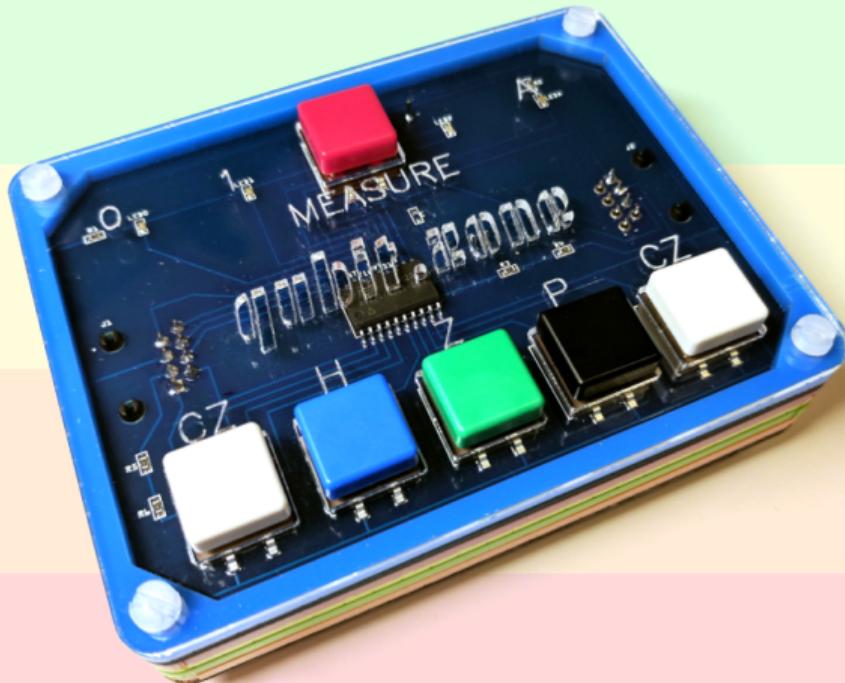
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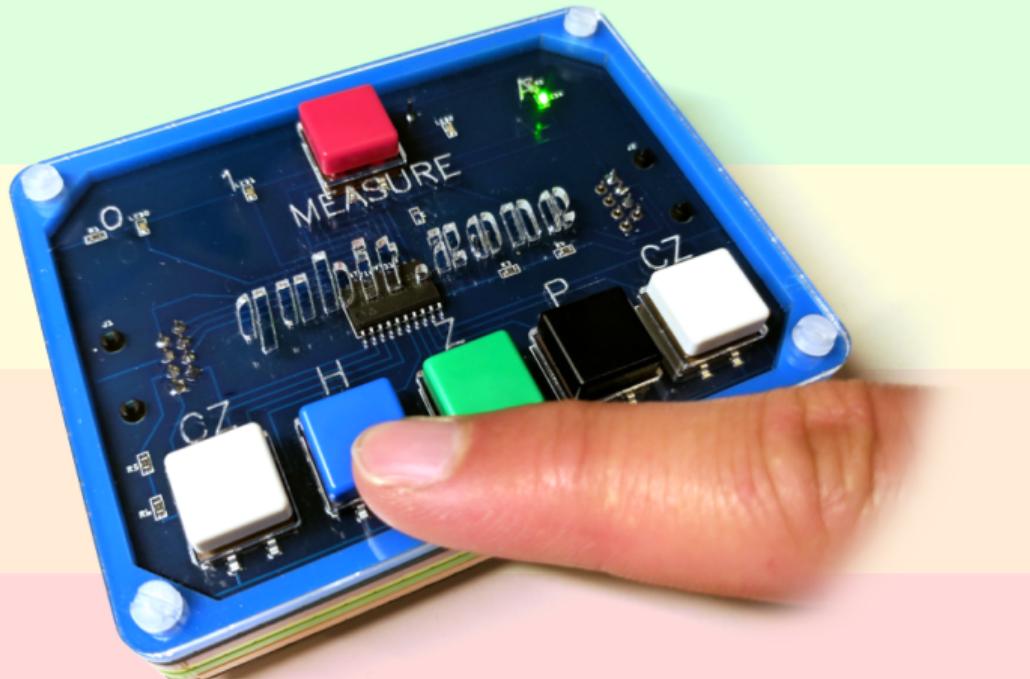


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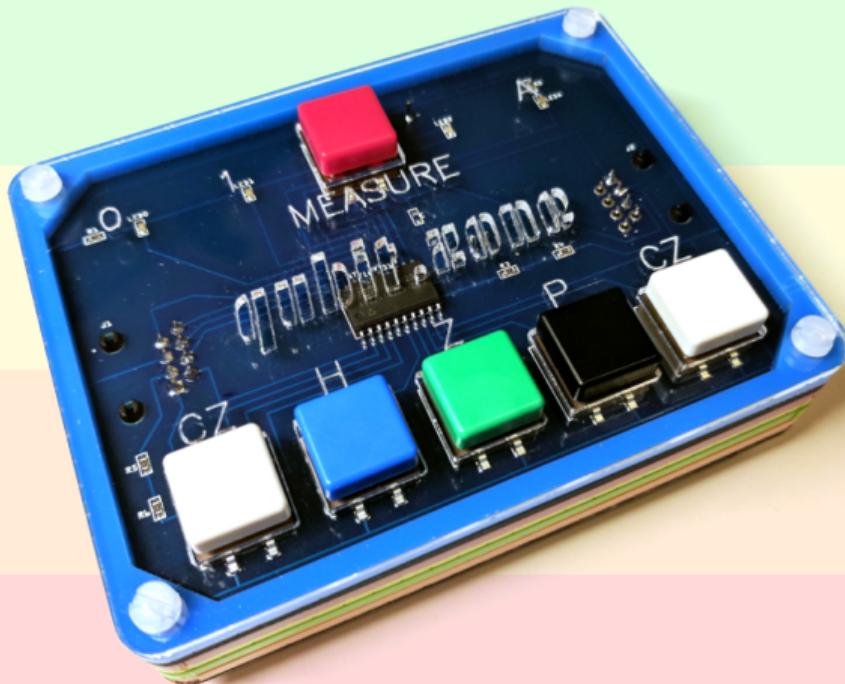


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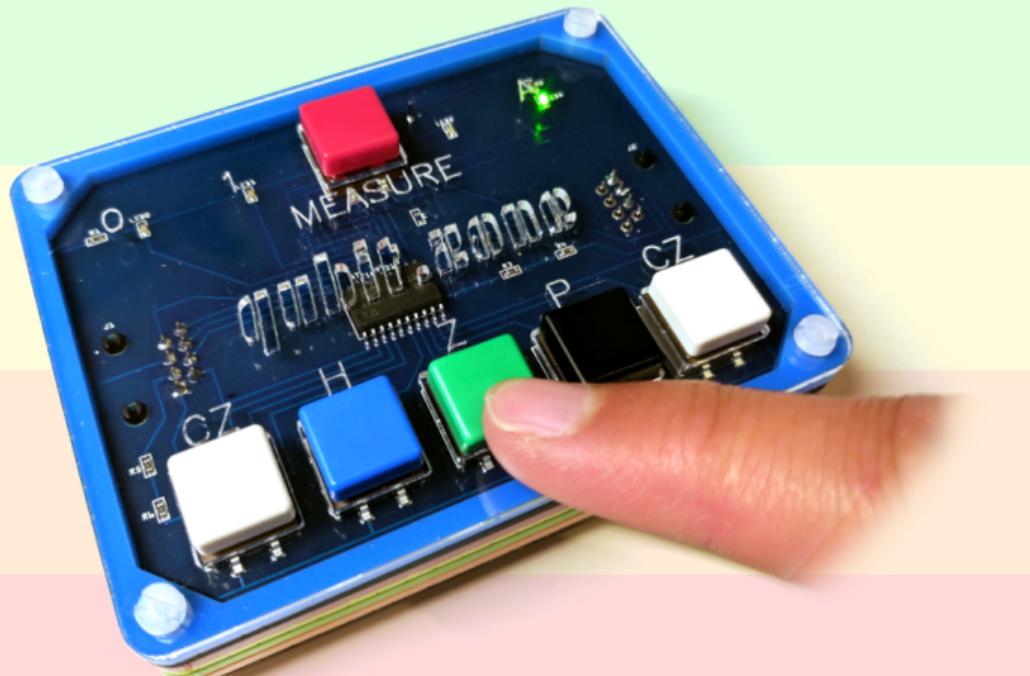


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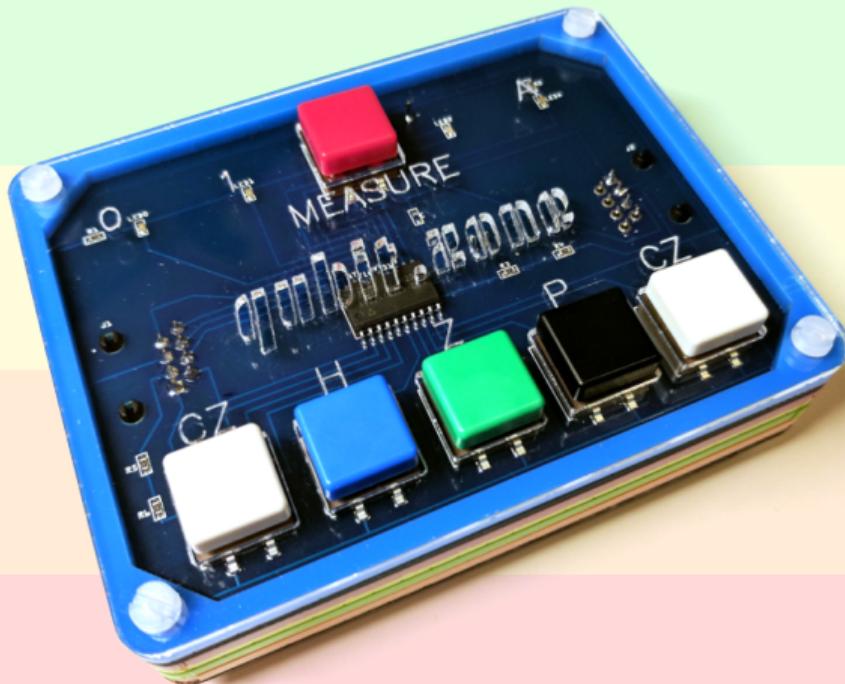


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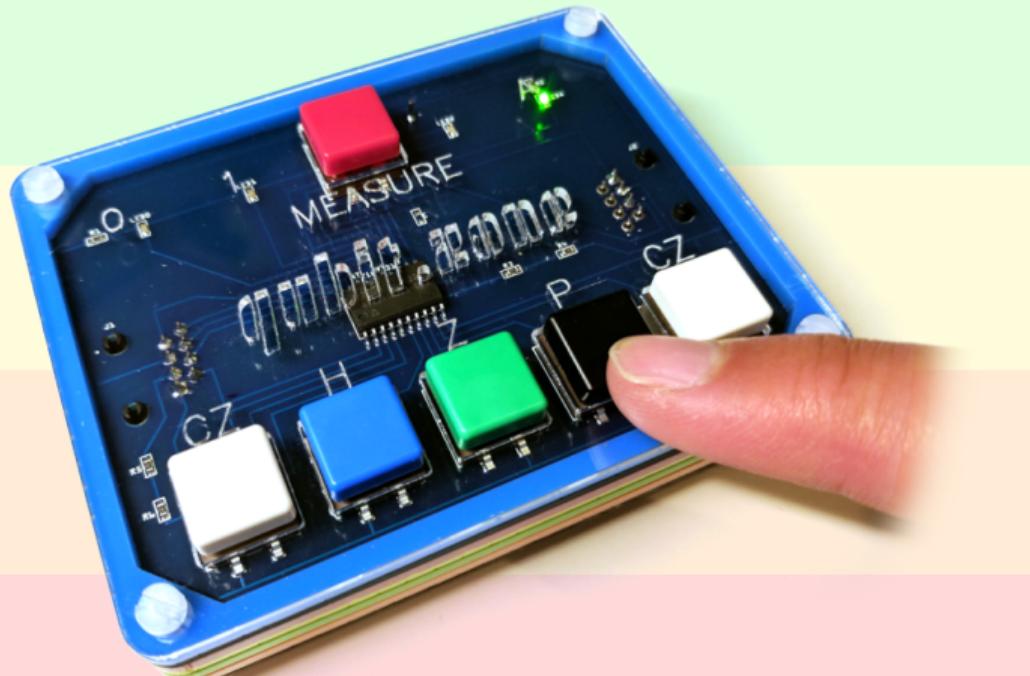


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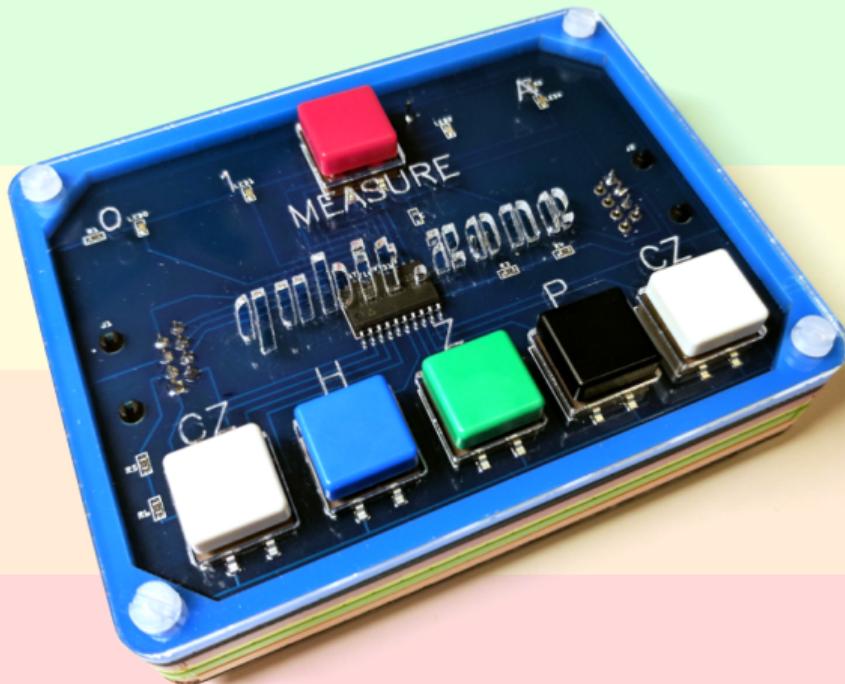


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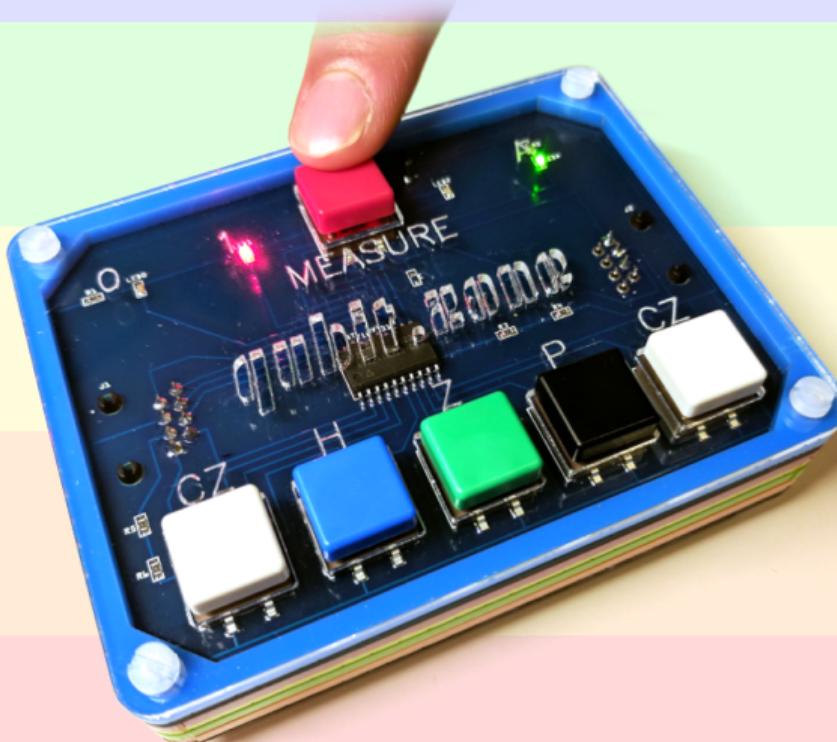
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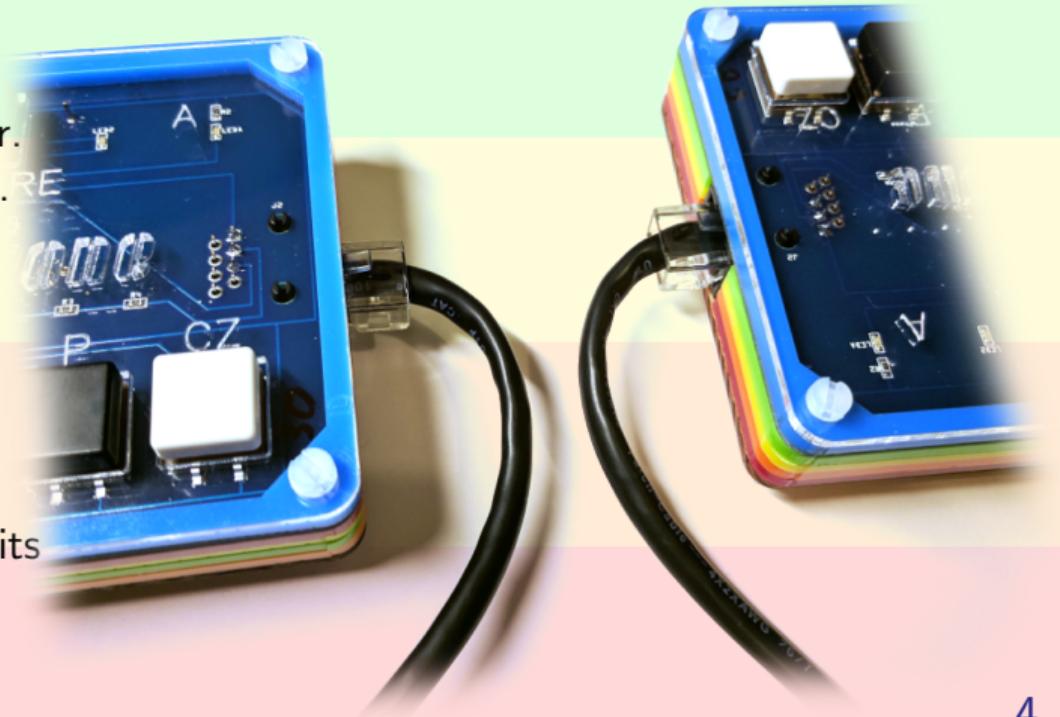
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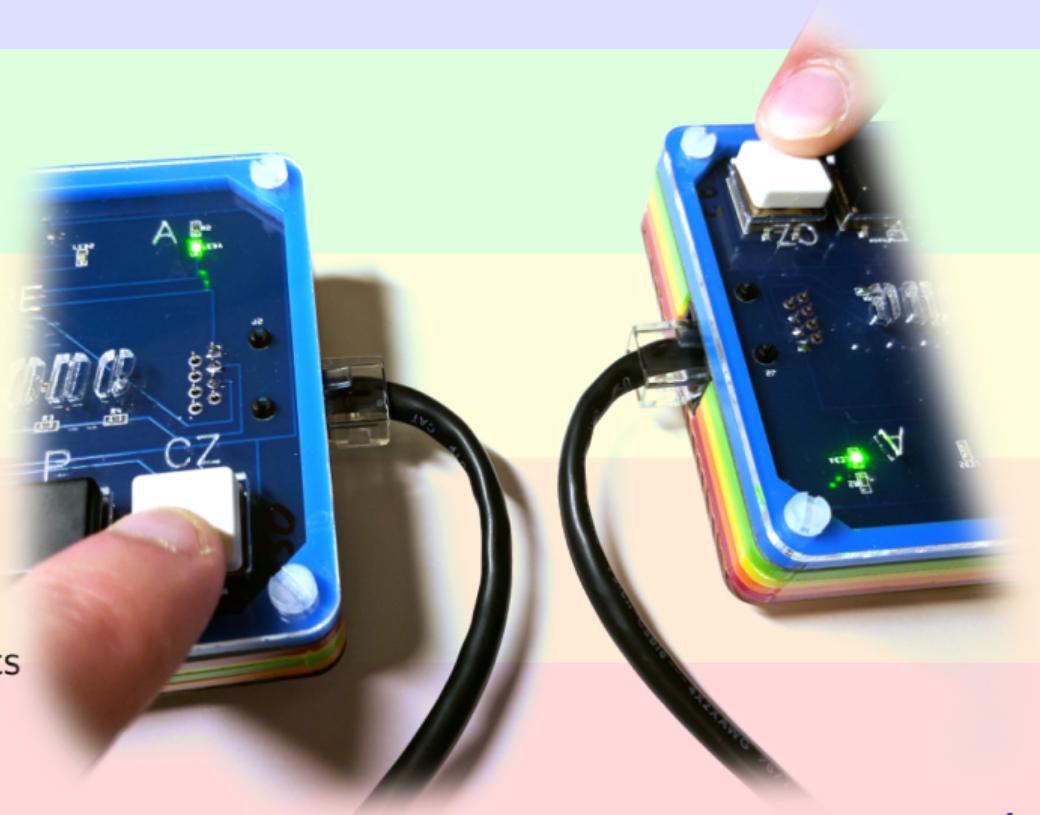
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On each qubit, press **CZ** buttons
by the cable at the same time.



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Scientists call this measurement. It *destroys* superposition.



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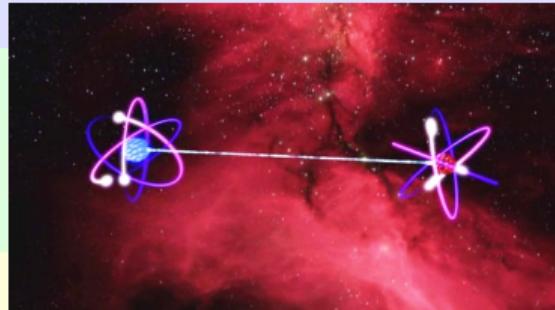
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Do this by pressing **H** then **M** repeatedly, until you get 0.

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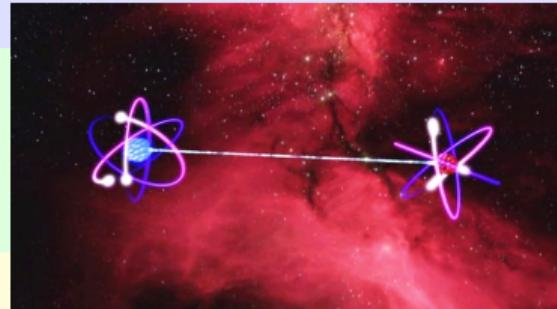
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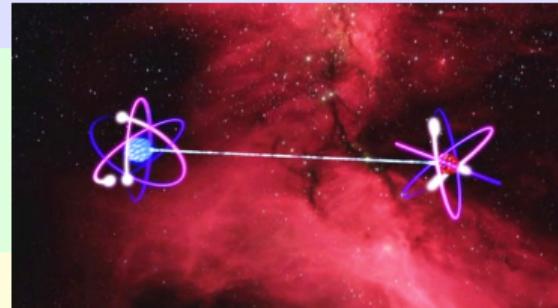


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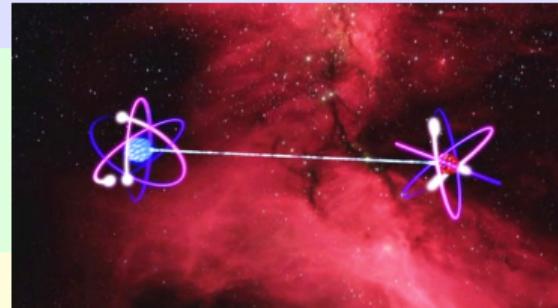


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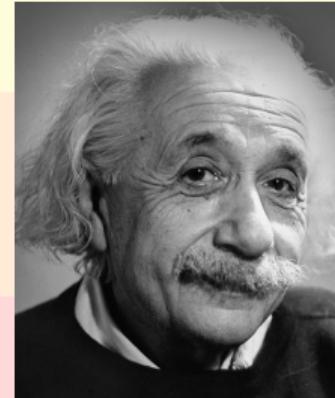
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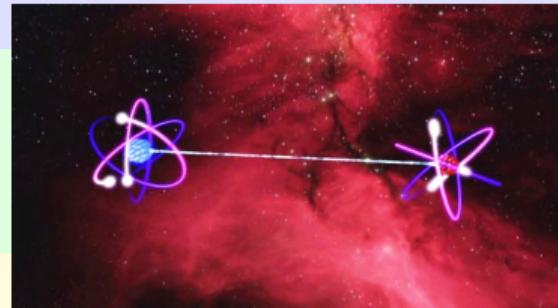


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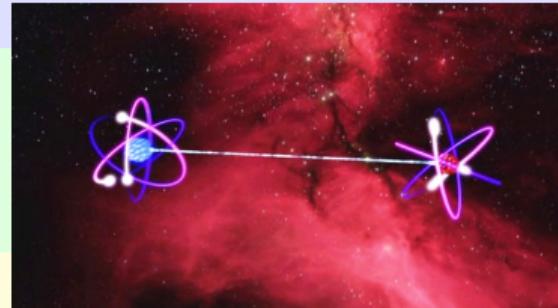
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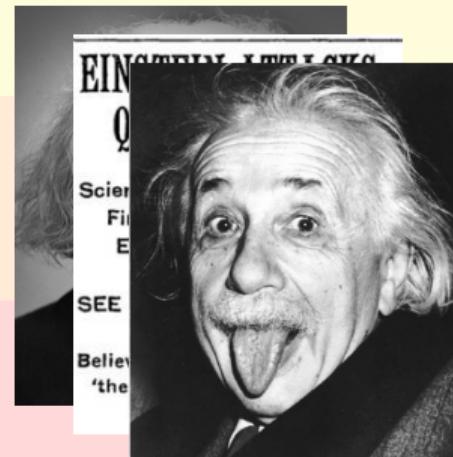
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He was wrong! Silly Einstein.



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You should get the same result!

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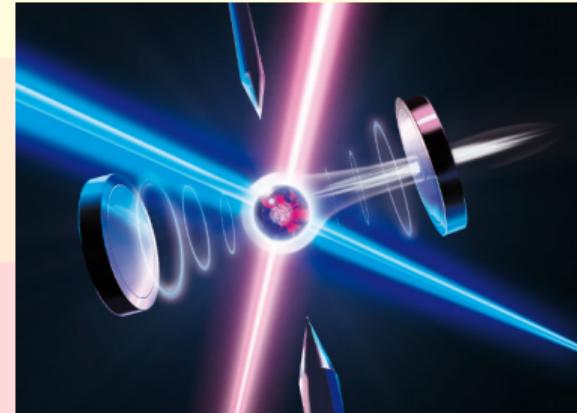
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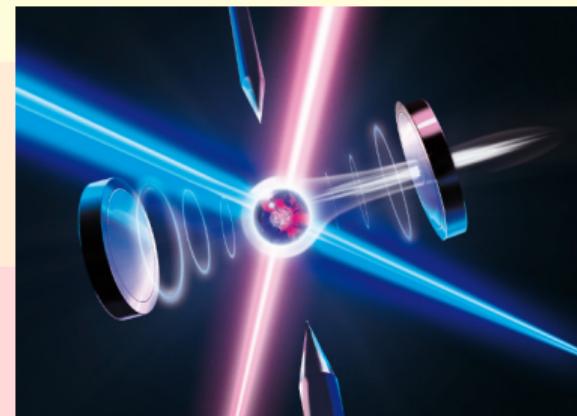
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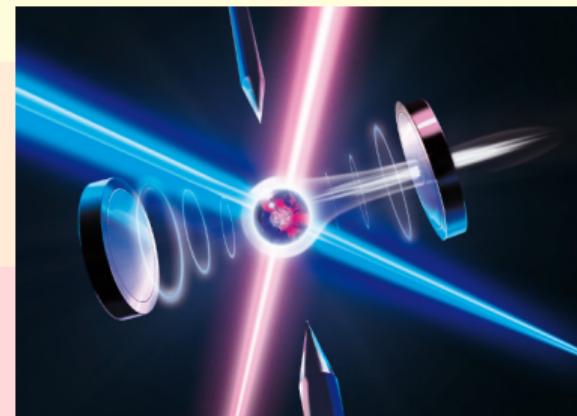
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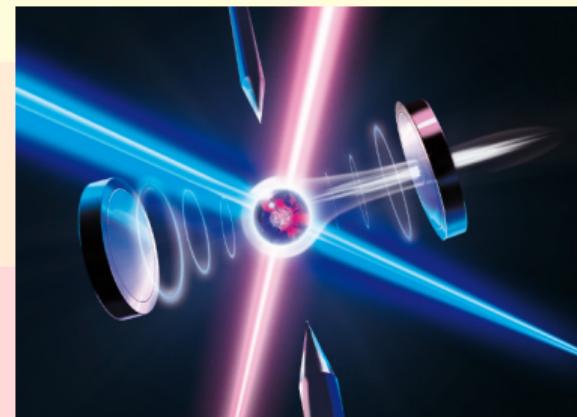
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There's a catch: the entanglement is *destroyed*.



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SUPER CODING

Let's try it! Get into pairs called Alice and Bob.

- ① Entangle your qubits

Alice's program:

Bob's program:

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We've encoded two bits in a single qubit!

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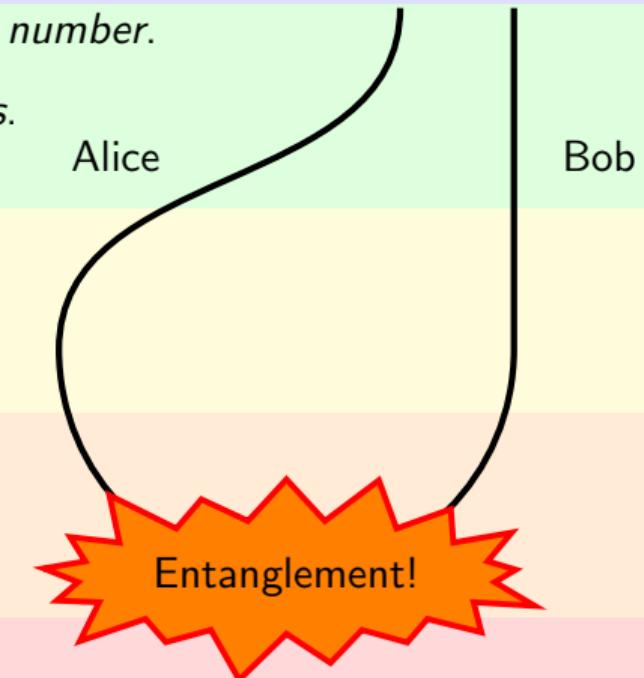
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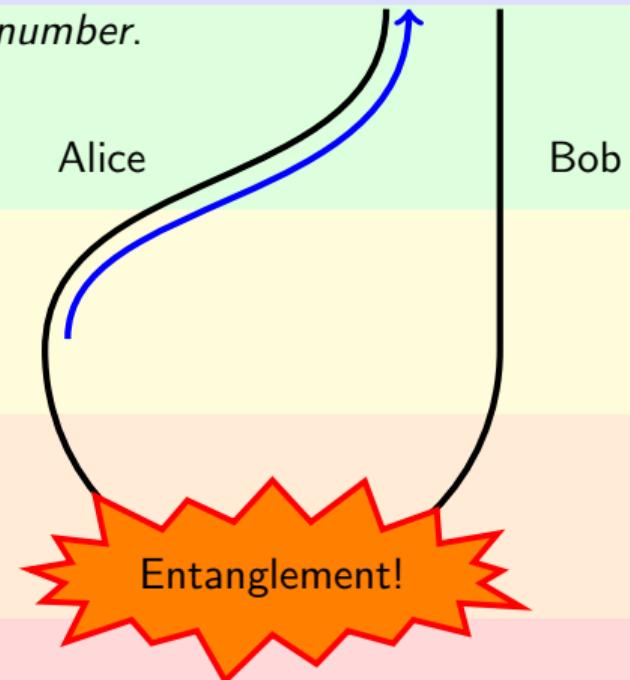
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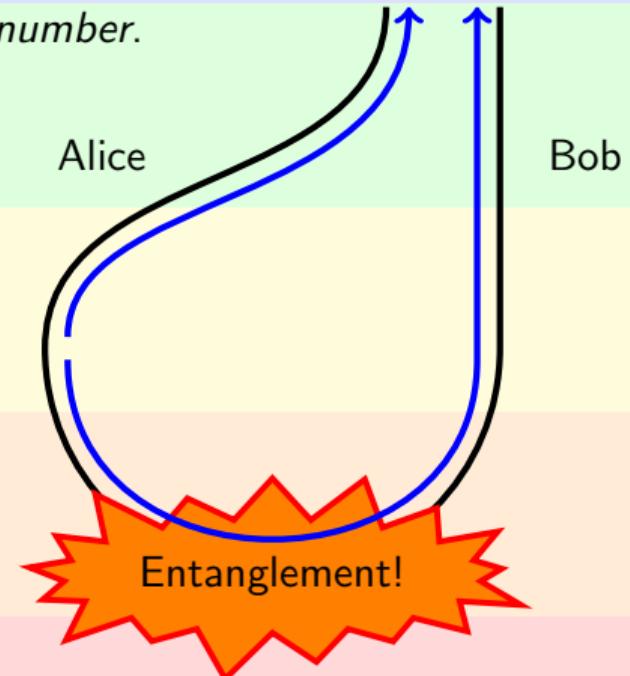
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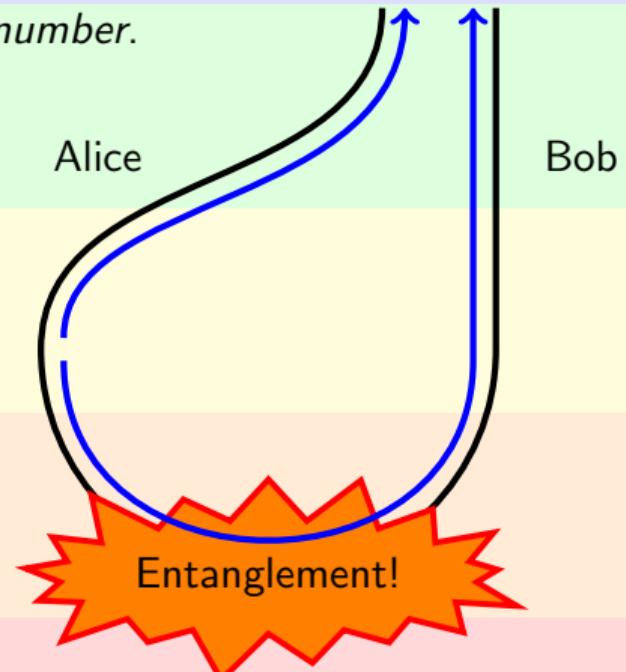
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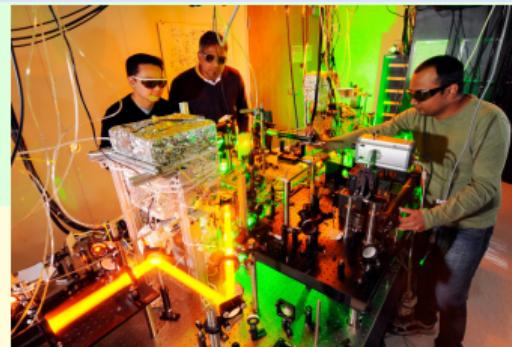
Some scientists have suggested the other number travels *back in time*, through the entangled state.

Probably not true. But it shows the difficulty scientists have understanding quantum computing.



TELEPORTATION

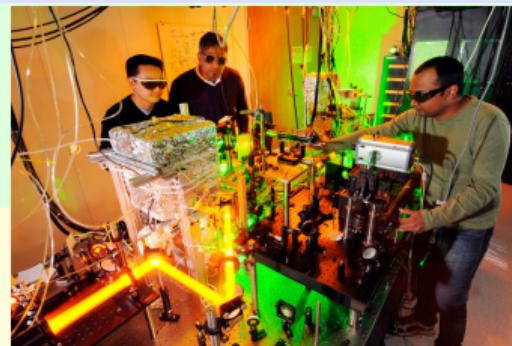
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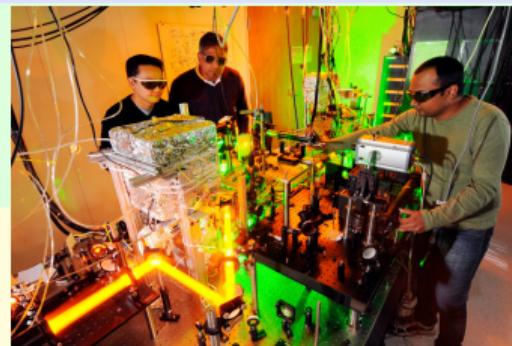
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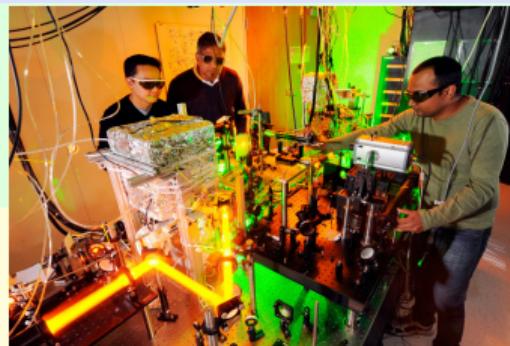


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TELEPORTATION

Quantum computers will need to move qubits around inside them.

One of the most powerful ways to do this is called *teleportation*.



This uses *entanglement* to move a qubit from one place to another.

It's not really what you're thinking of... but in the future, who knows?



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Let's try it! Get into threes called Alice, Bob and Charlie.

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- (a) Alice and Bob, both store 0 in your qubits
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- a Alice and Bob, both store 0 in your qubits
- b Alice and Bob, both press H
- c Alice and Bob, connect a cable and both press CZ

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- c Alice and Bob, connect a cable and both press CZ
- d Remove the cable

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- d) Remove the cable
- e) Alice, press 

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Charlie's qubit has now been teleported to Alice!

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- ③ Bob and Charlie, connect a cable, and both press **CZ**
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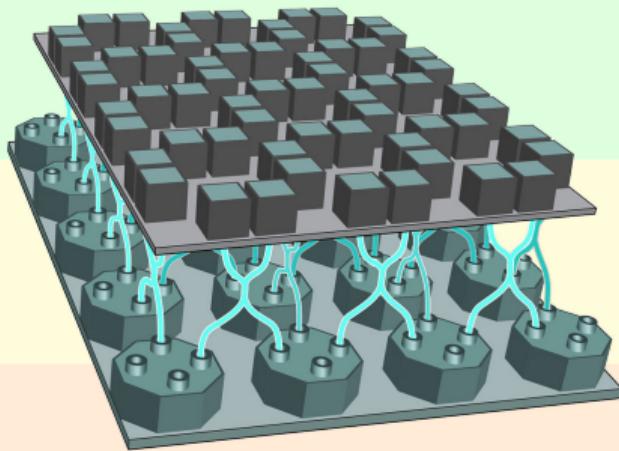
- ⑥ Alice, press **M** to discover Charlie's secret number

REAL QUANTUM COMPUTERS

Real quantum computers don't exist yet.

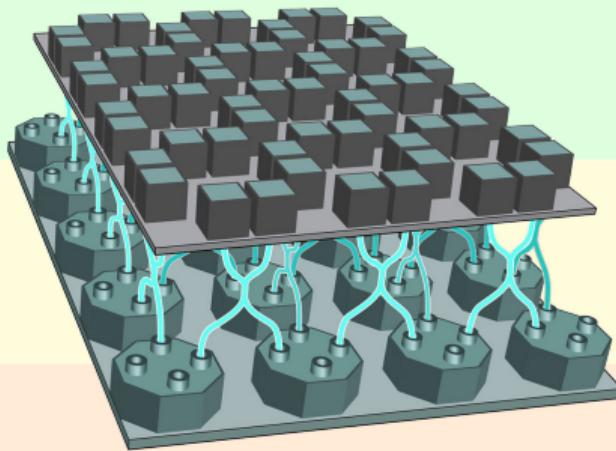
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REAL QUANTUM COMPUTERS

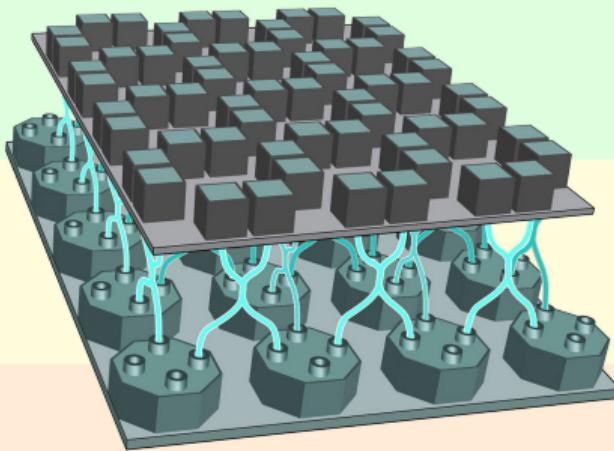
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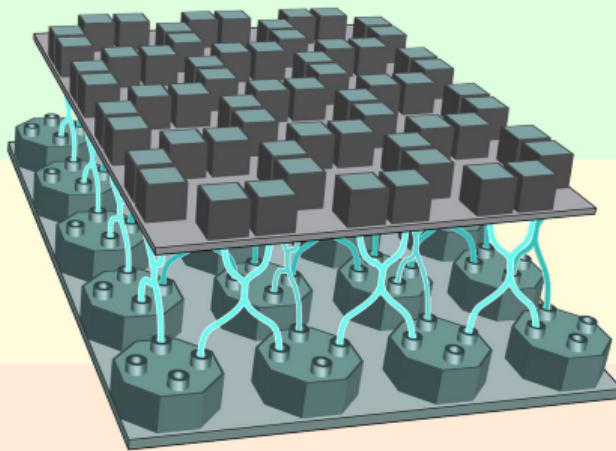


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It's hard because *errors* can easily accumulate.

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⋮

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Last Step. Last two qubits press CZ, then last qubit press H

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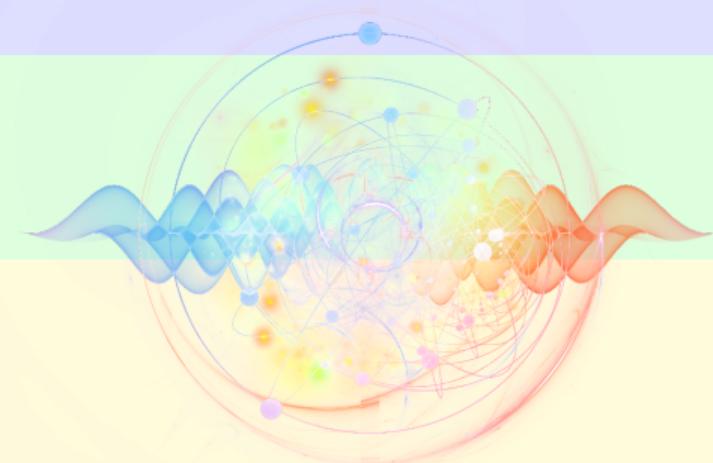
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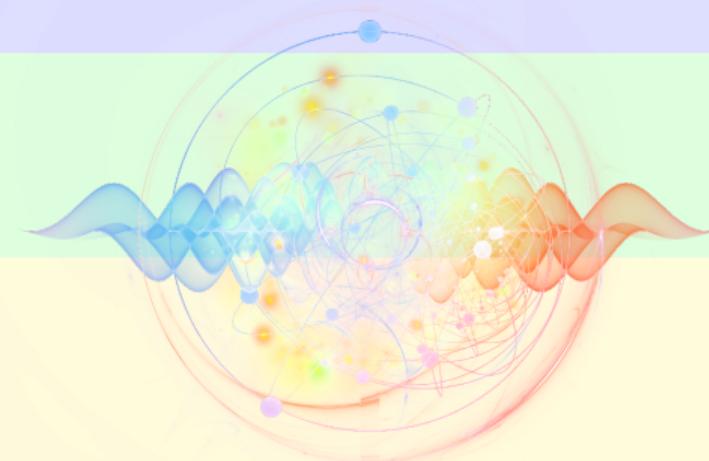
Everybody, press M to measure your qubit!

THE END

We've explored some incredible quantum phenomena:



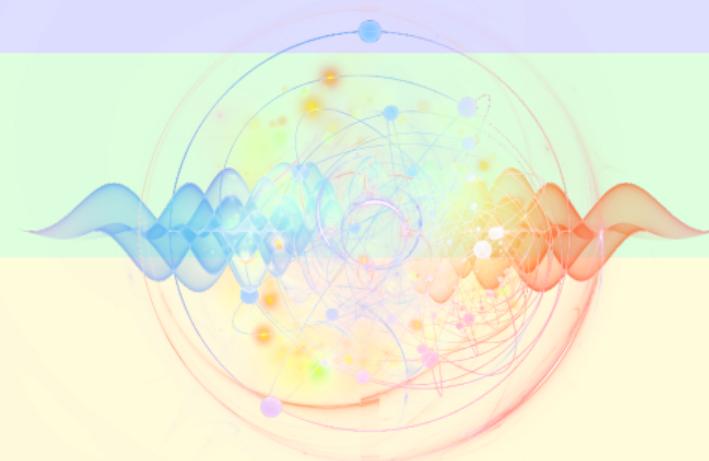
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A circular illustration on the left side of the slide depicts a complex quantum system. It features concentric rings in various colors (blue, red, yellow, green) representing different energy levels or orbits. Numerous small, colorful dots (representing particles like electrons) are scattered throughout the rings. Two prominent wavy lines, one blue and one red, extend from the bottom left towards the center, symbolizing wave functions or interference patterns.

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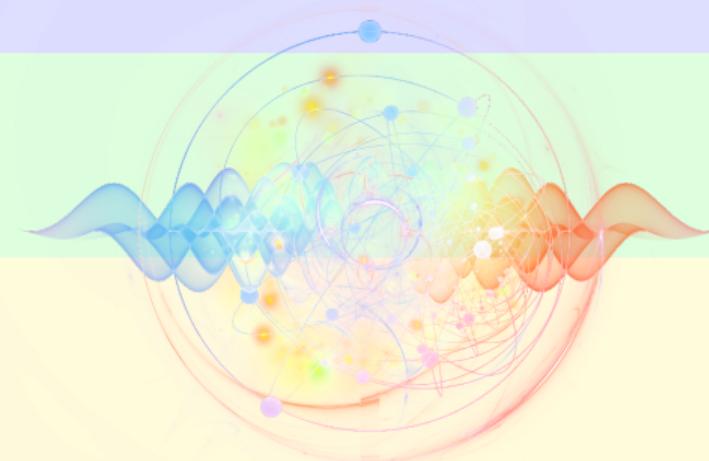
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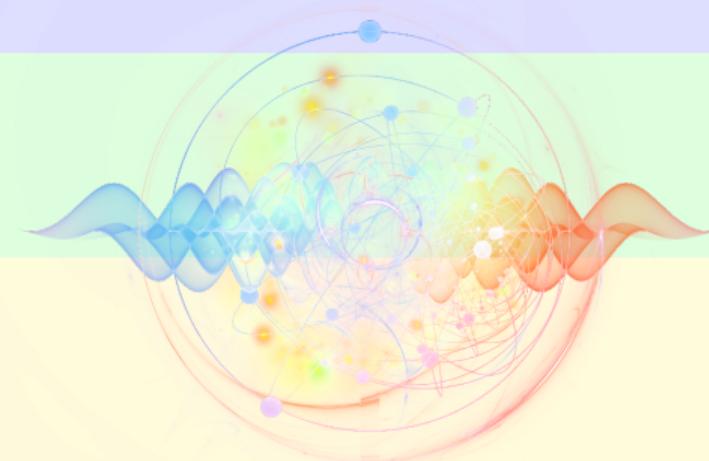
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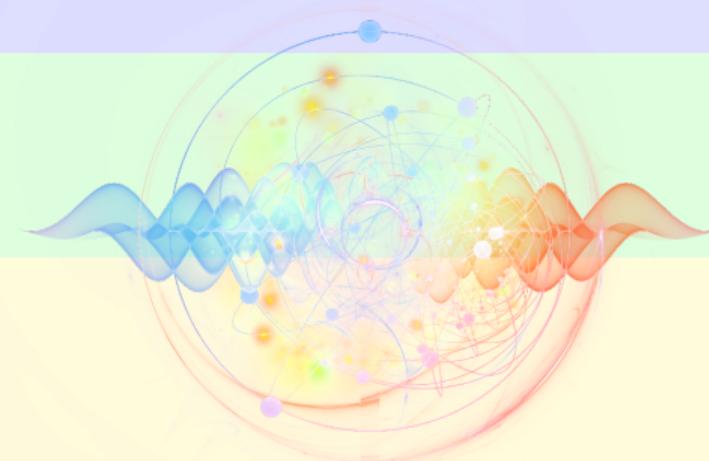
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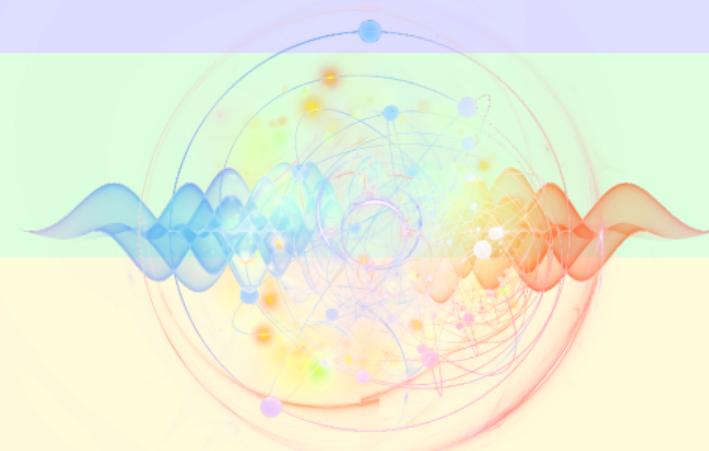
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But *when* will quantum computers arrive?

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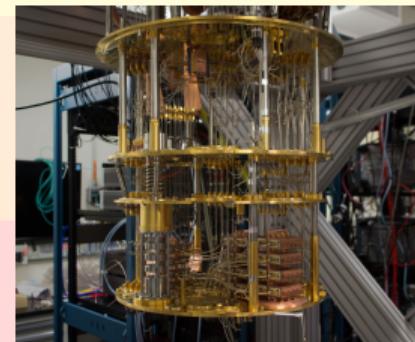


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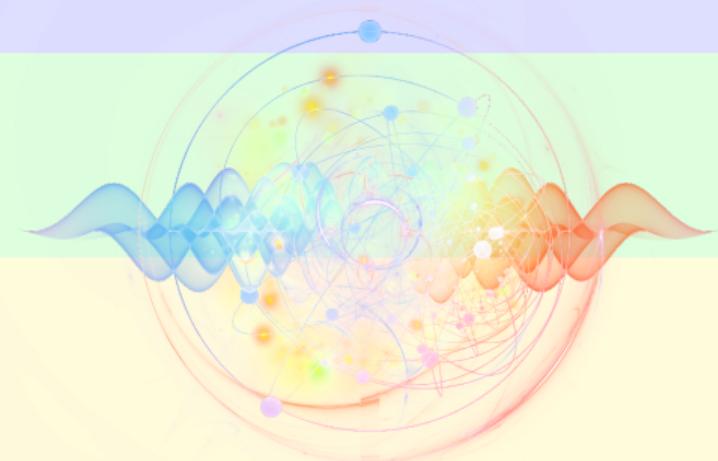
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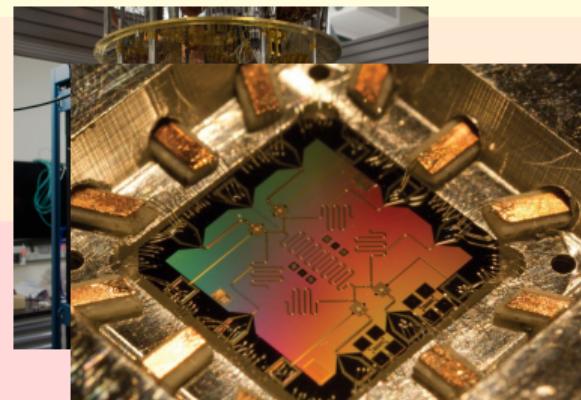
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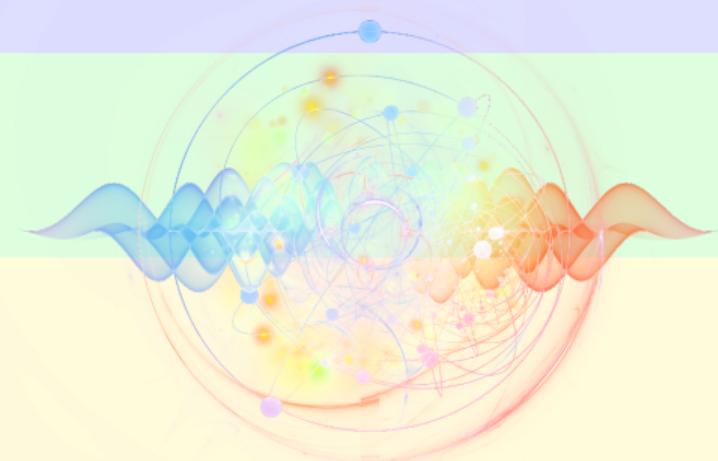
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The quantum revolution is about to begin!

