

# Quantum Supremacy

What's in it for me?

Next year, I'll be up here  
talking about algorithms.

The year after that I'll be up here  
talking about applications.

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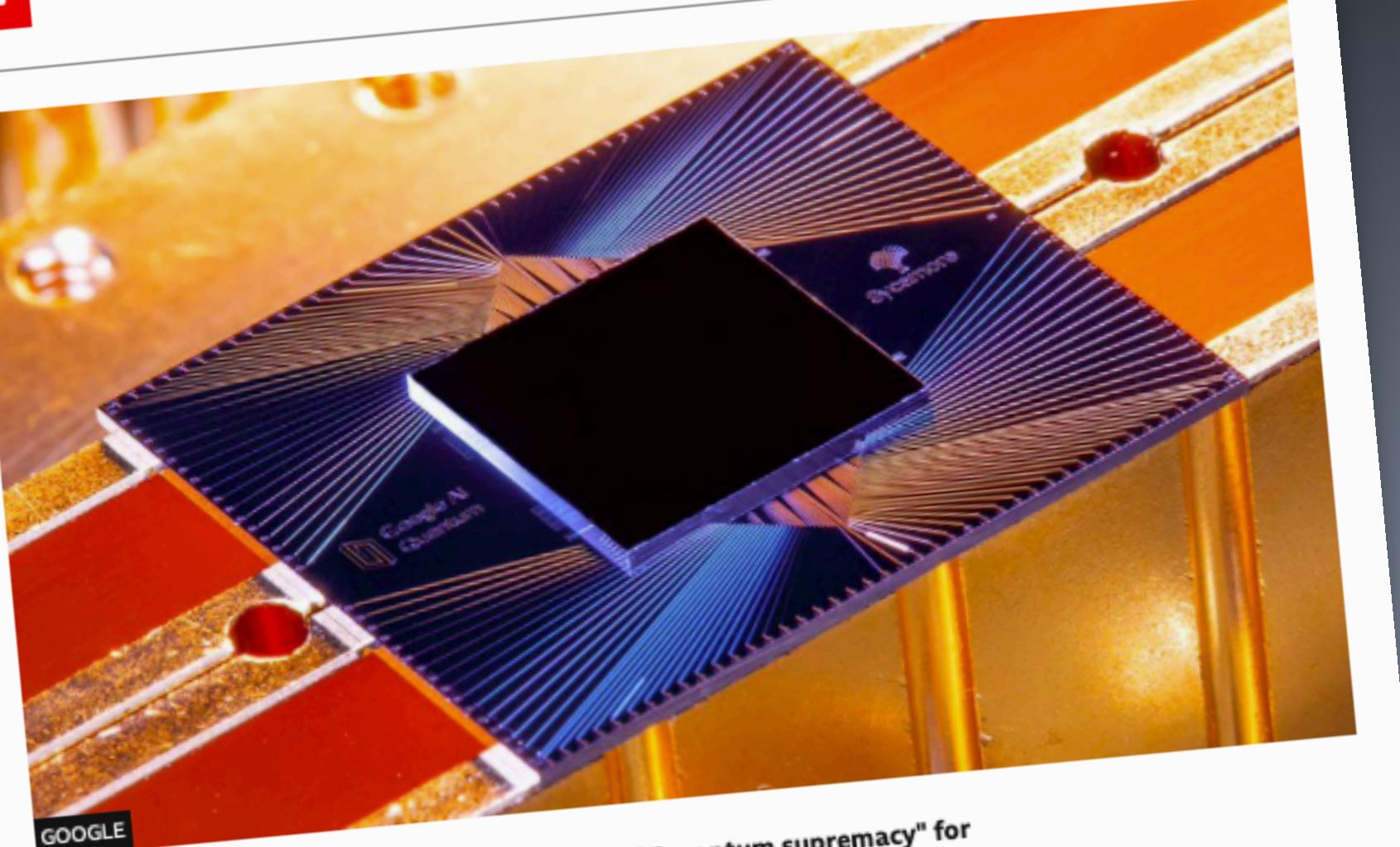
## NEWS

Science & Environment

### Google claims 'quantum supremacy' for computer

By Paul Rincon  
Science editor, BBC News website

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GOOGLE

Google says an advanced computer has achieved "quantum supremacy" for the first time, surpassing the performance of conventional devices.

The technology giant's Sycamore quantum processor was able to perform a specific task in 200 seconds that would take the world's best supercomputer 10,000 years to complete.

Scientists have been working on quantum computers for decades because they promise much faster speeds.

The result appears in [Nature journal](#).

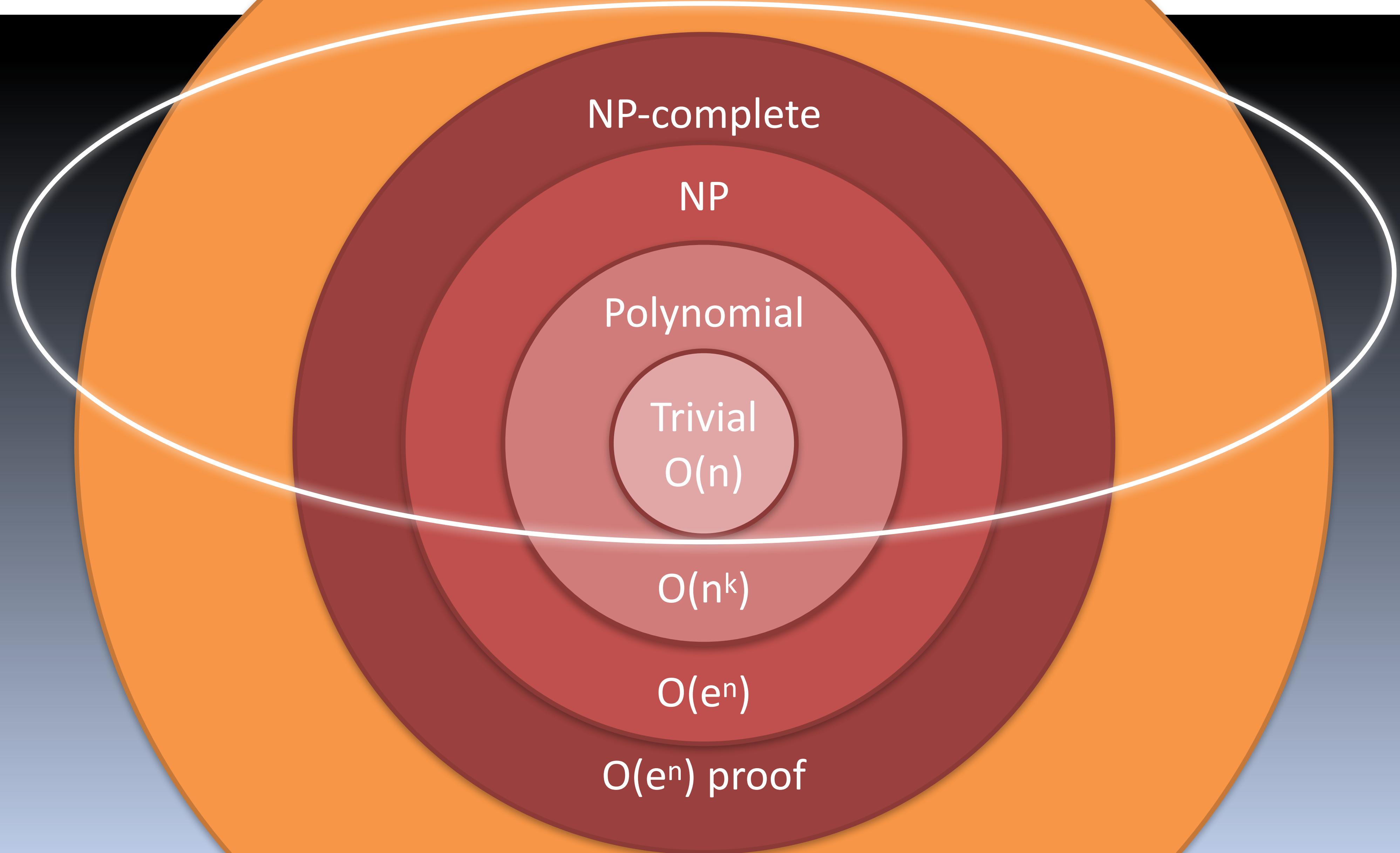
In classical computers, the unit of information is called a "bit" and can have a value of either 1 or 0. But its equivalent in a quantum system - the qubit - can be both 1 and 0 at the same time.

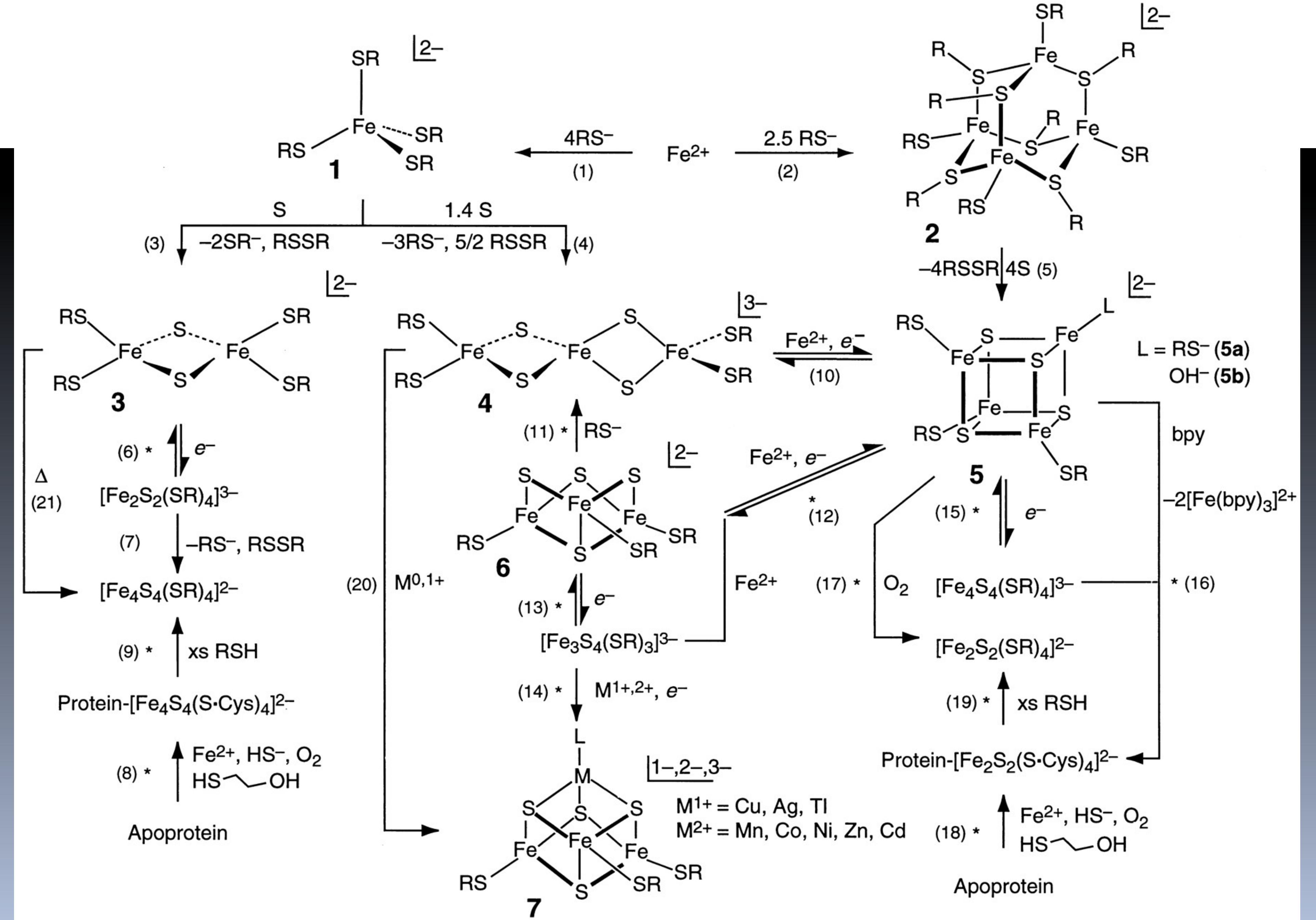


A large, white, three-dimensional question mark graphic is positioned in the center of the image. It has a thick outline and a slight shadow, giving it a floating appearance against a dark gray background. The background is set against a dark blue background with a faint, glowing network of white lines, suggesting a digital or technological theme.

- What, exactly, did they do?
- What is a “Quantum Computer” anyway?
- Should I be interested in it?

# What's wrong with classical computers?





# A brief history

- 1982: Feynman proposed a quantum computer
- 1985: David Deutsch developed the Universal Quantum Machine (Quantum Turing Machine)
- 1994: Shor's factorisation algorithm
- 1997: Grover's search algorithm
- 2001: First quantum computer (7 bits)

# {SDD} 2022

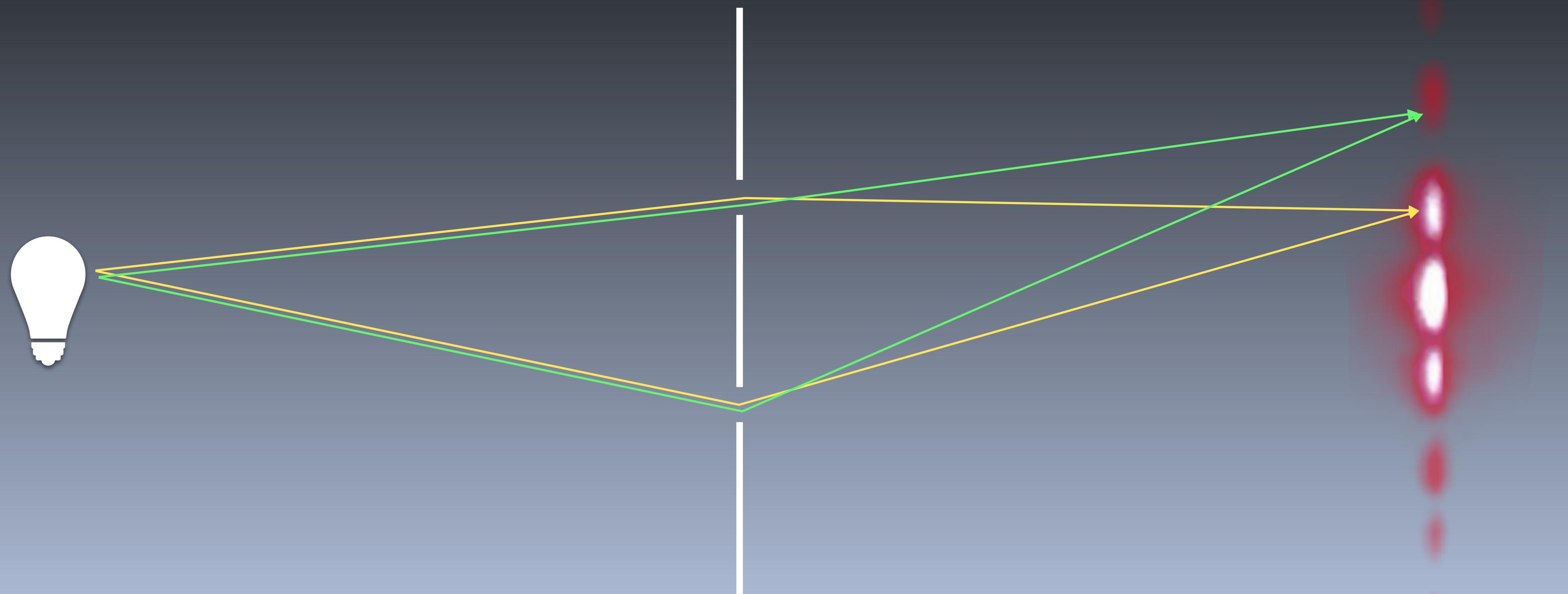
Software Design & Development  
London, 16-20 May 2022



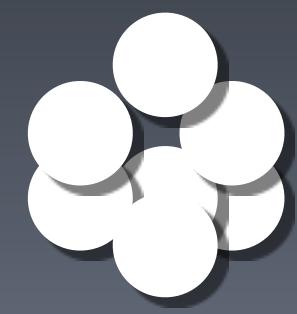
# How is the QC used?



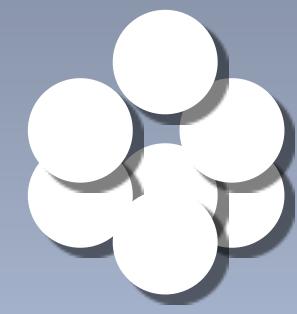
# Superposition and collapse



# Qubits

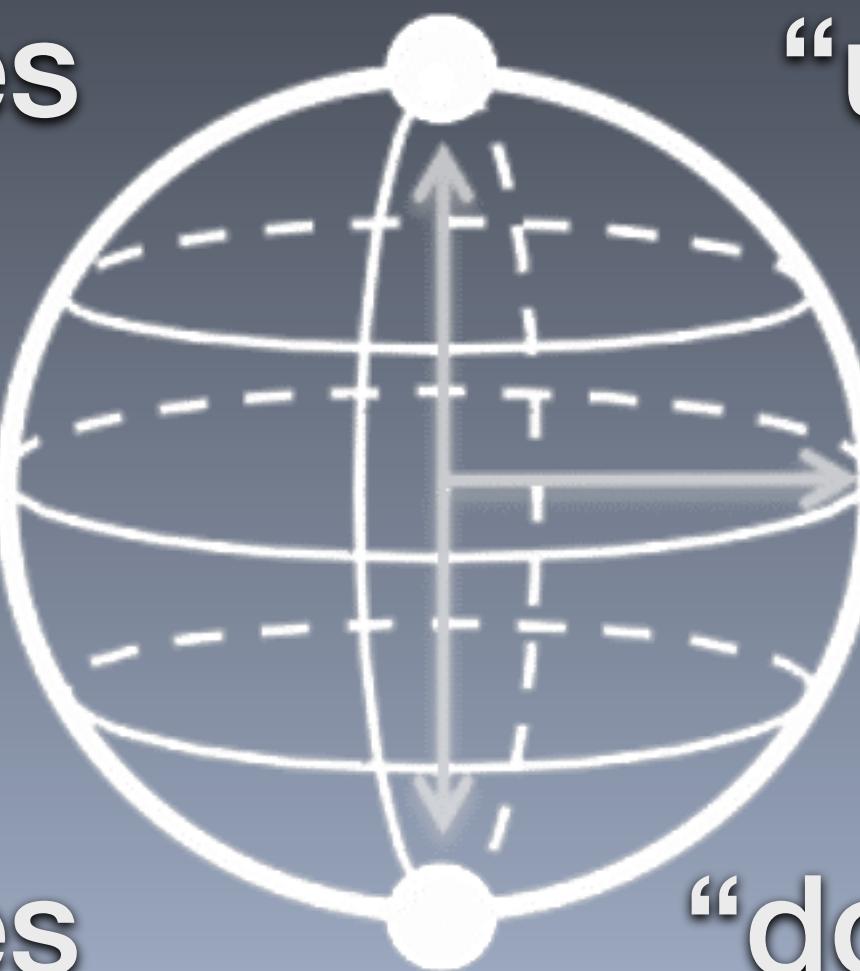


“0” state



“1” state

“0” states



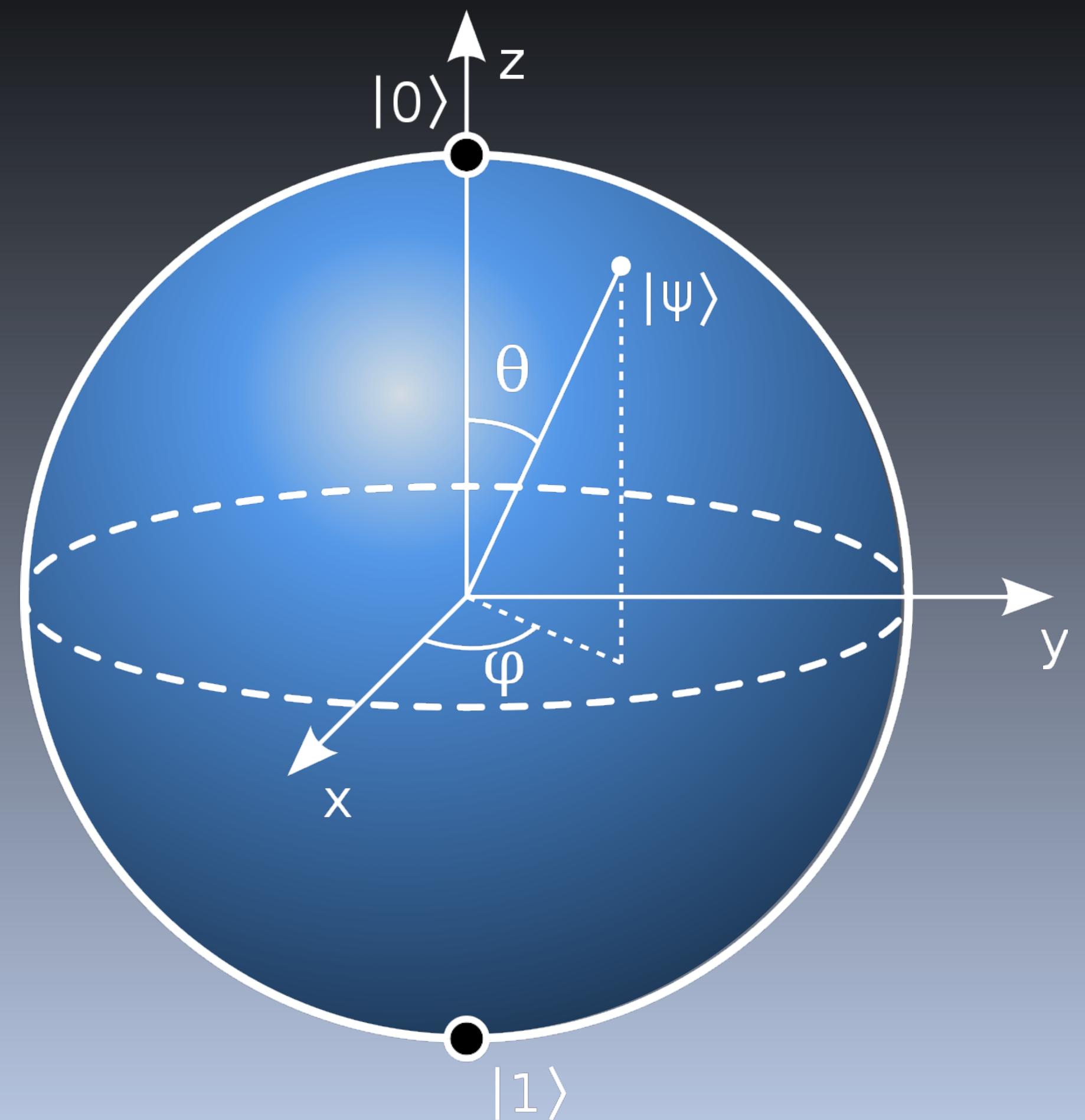
“1” states

“up”

“down”

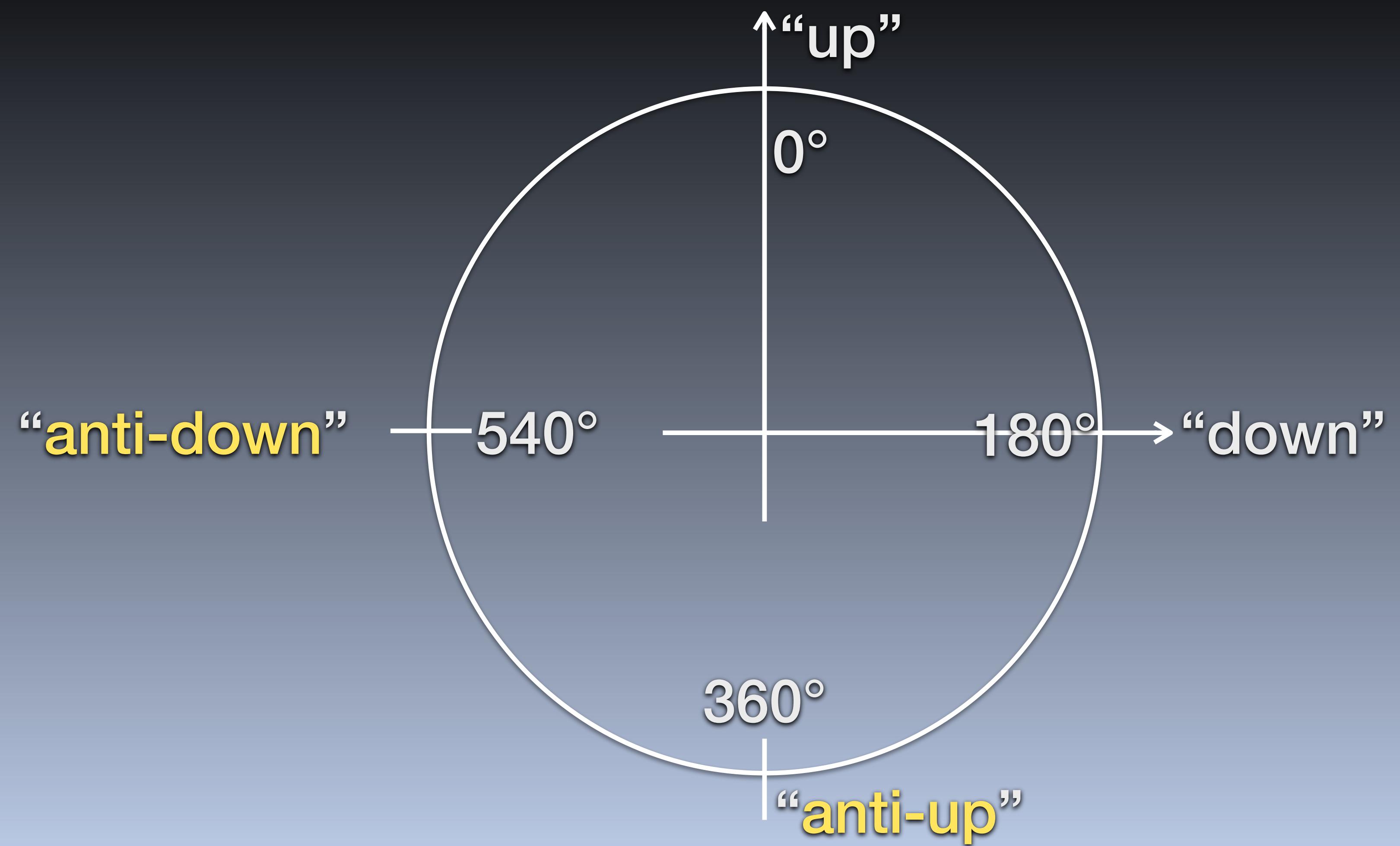
# Qubits

The Bloch sphere

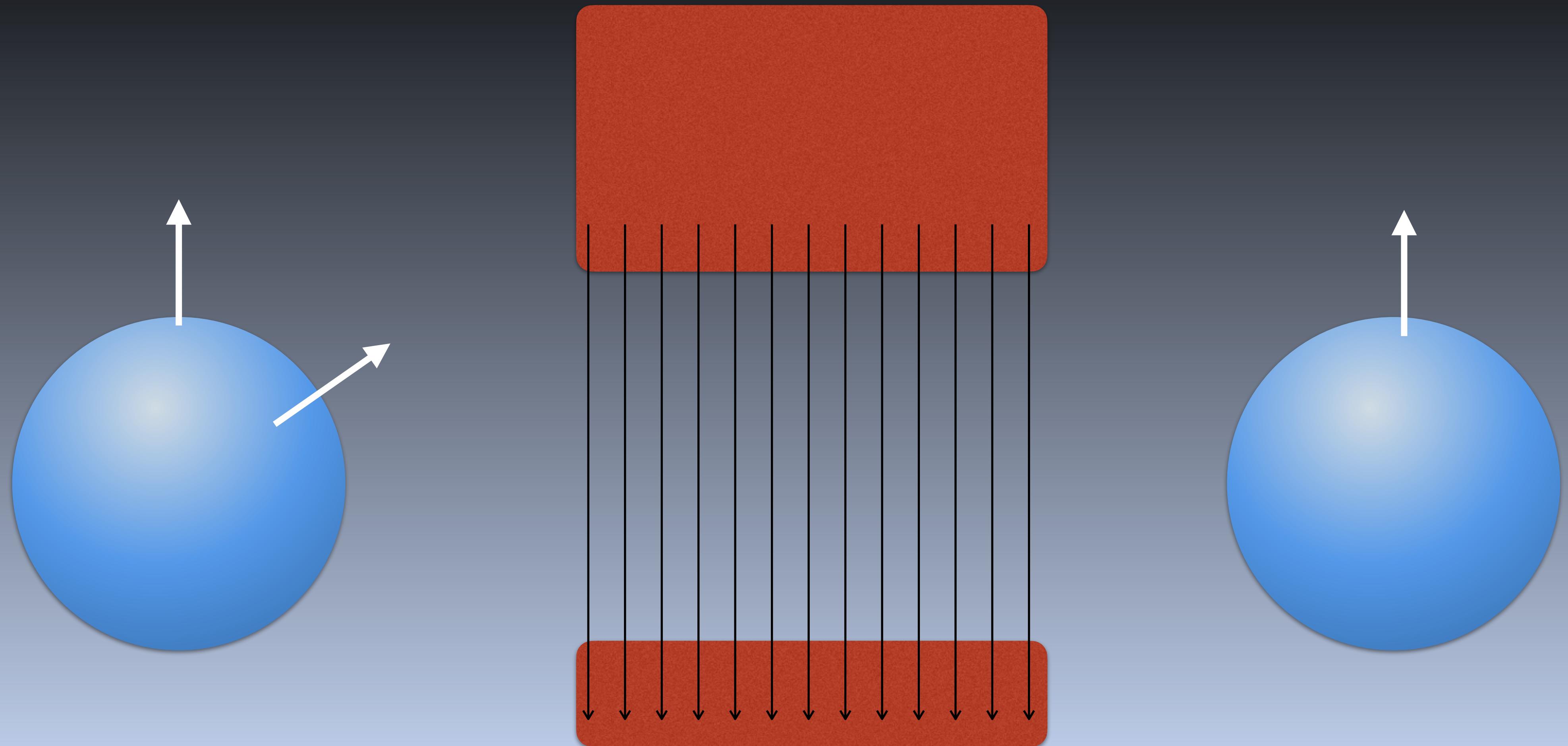


# Qubits

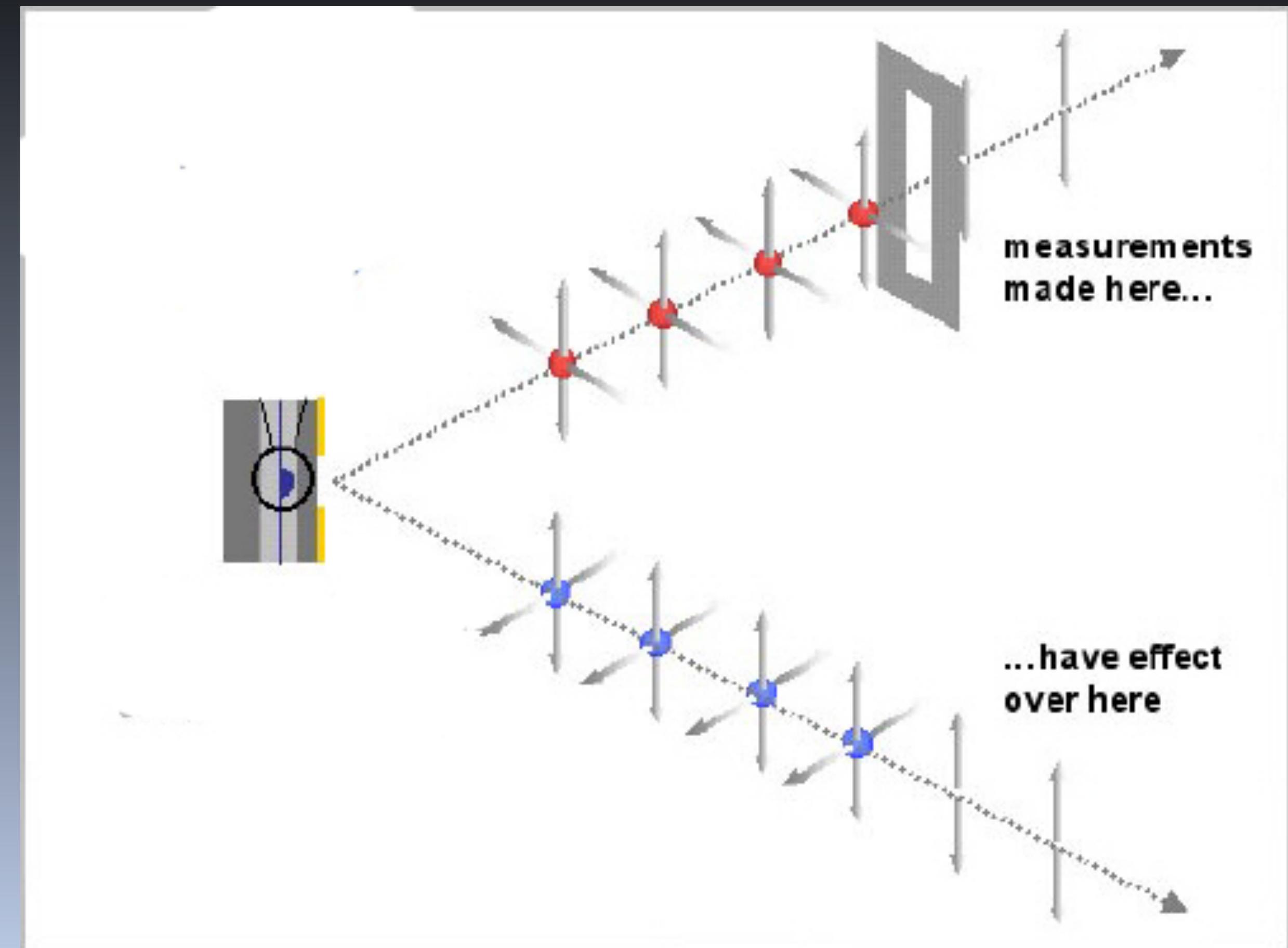
The Lie field



# Collapsing the Qubit



# Entanglement



# So, what does a quantum computer do?

- Construct a problem definition: initialise qbits *May be a superposition*
- Transform the problem, using a combination of:
  - rotations
  - entanglements*This is the program*
- Collapse the transformed problem *Generate a possible result*

*Rinse and repeat*



Demo



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A quantum computer that measures up to the hype has reached a new milestone.

Quantum internet signals beamed between drones a kilometre apart

Quantum computers can now fix their own mistakes without making more

First fully programmable quantum computer based on neutral atoms

Most quantum computers are based on superconductors or trapped ions, but an alternative approach using ordinary atoms may have advantages.

Google demonstrates vitrification towards large-scale quantum computers

Quantum computers can now fix their own mistakes without making more

Quantum computer helps to design quantum computer

Honeywell claims it has built the most powerful quantum computer ever

First ever quantum chess tournament won by Amazon

City-wide quantum data network in China is the largest ever built

IBM creates largest ever superconducting quantum computer

IBM has made a 127-qubit quantum computer. This is over double the size of comparable machines made by Google and the University of Science and Technology of China.

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Quantum computer helps to design quantum computer

Honeywell claims it has built the most powerful quantum computer ever

First ever quantum chess tournament won by Amazon

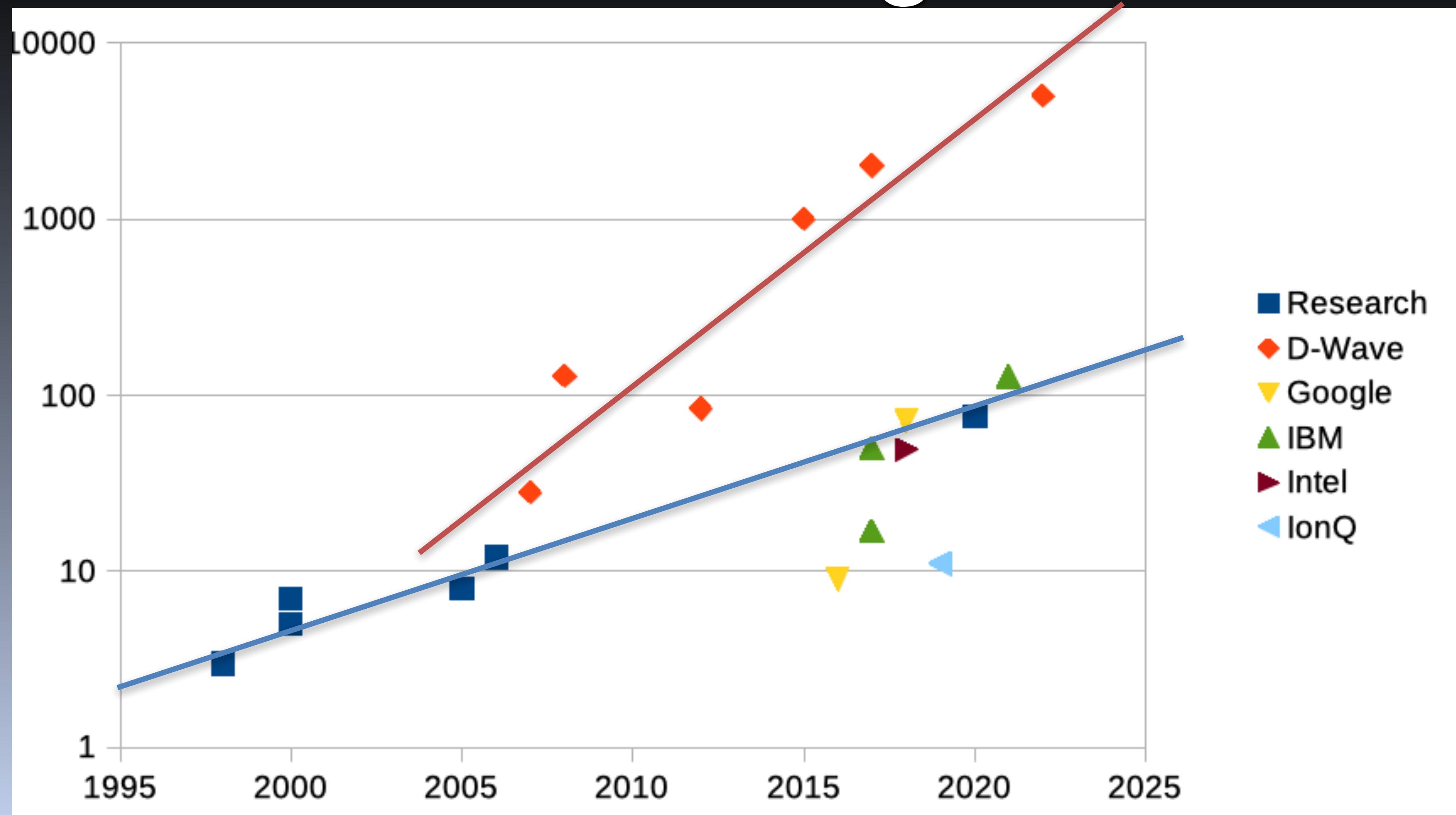
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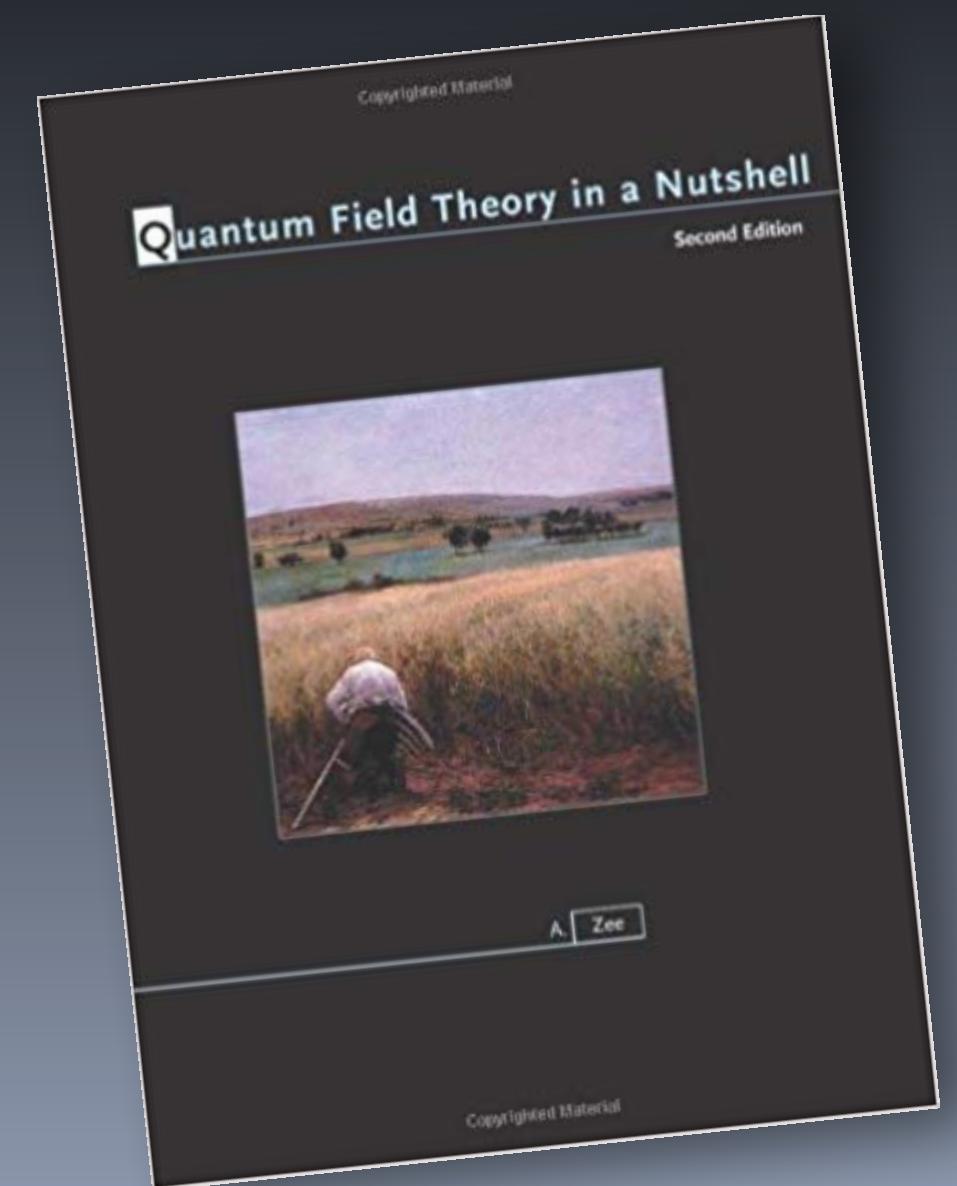
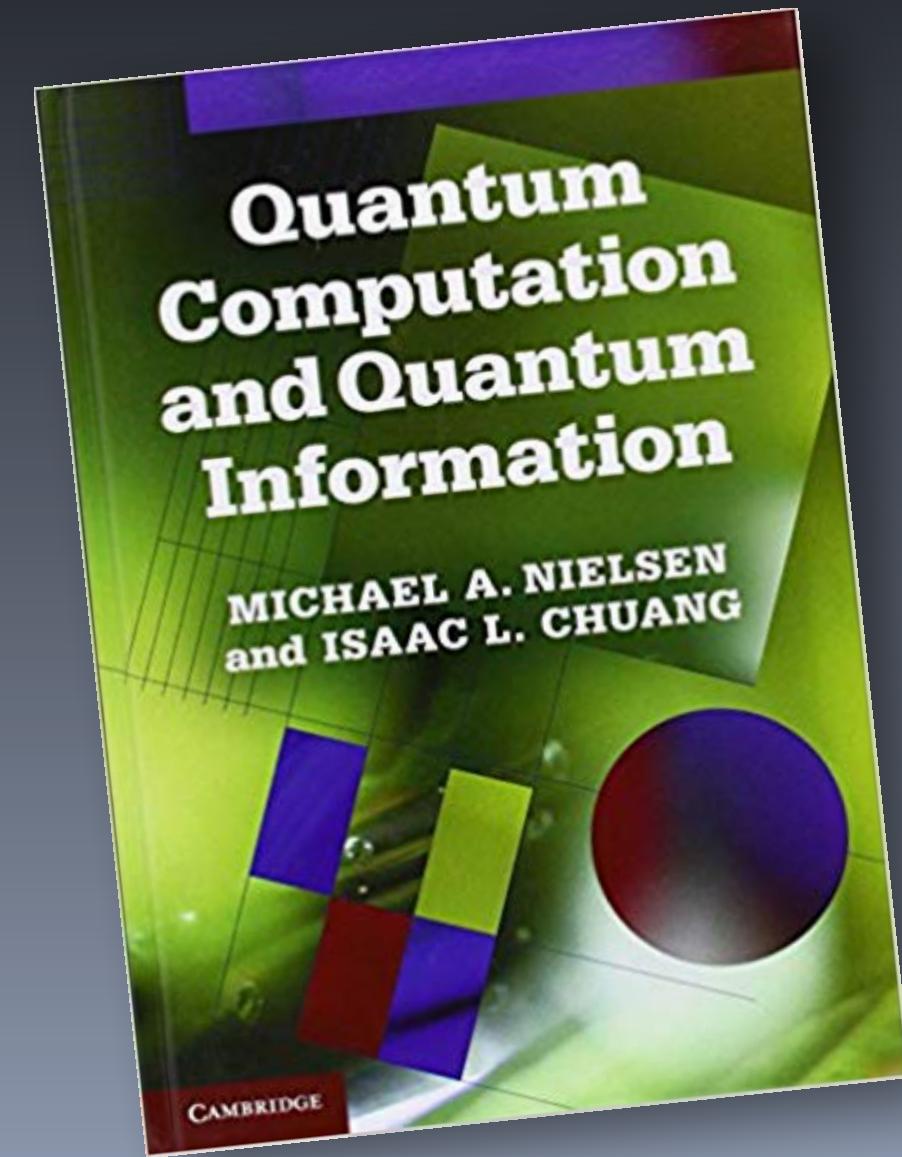
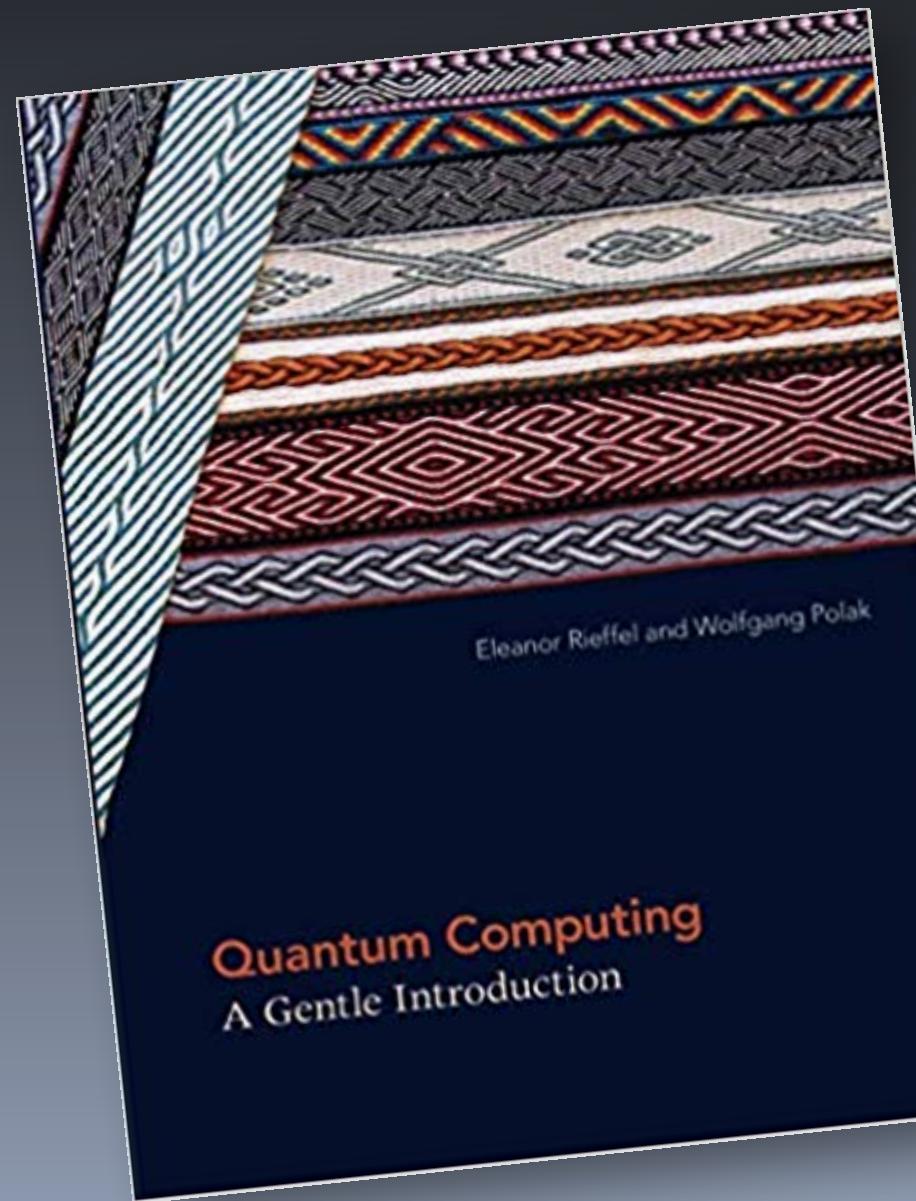
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# What's coming next?



# Cryptography

# Resources



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