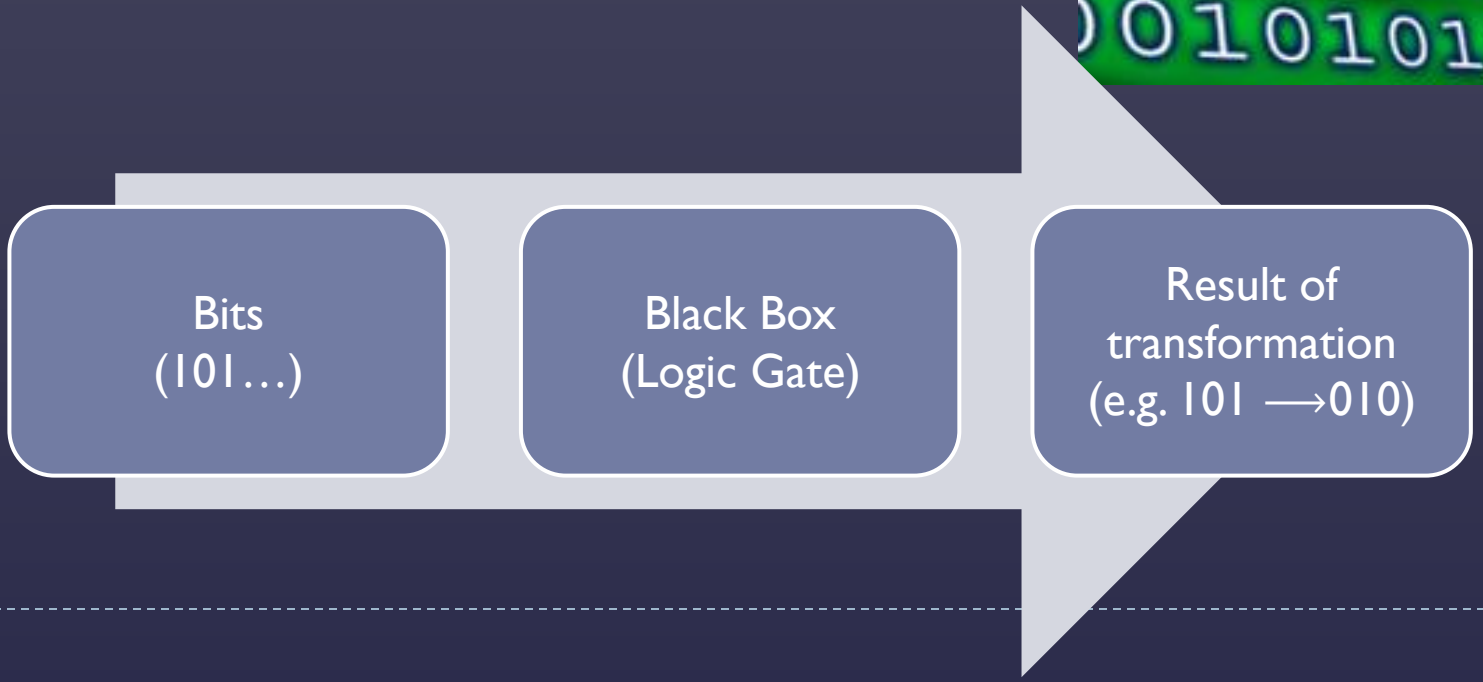
QUANTUM COMPUTATION

A theoretical outlook to building a quantum computer

The modern computer

- Information in computers are stored as **bits** (1's and 0's)
- Bits are voltage or current pulses
- We compute on these bits by electronic **logic gates**

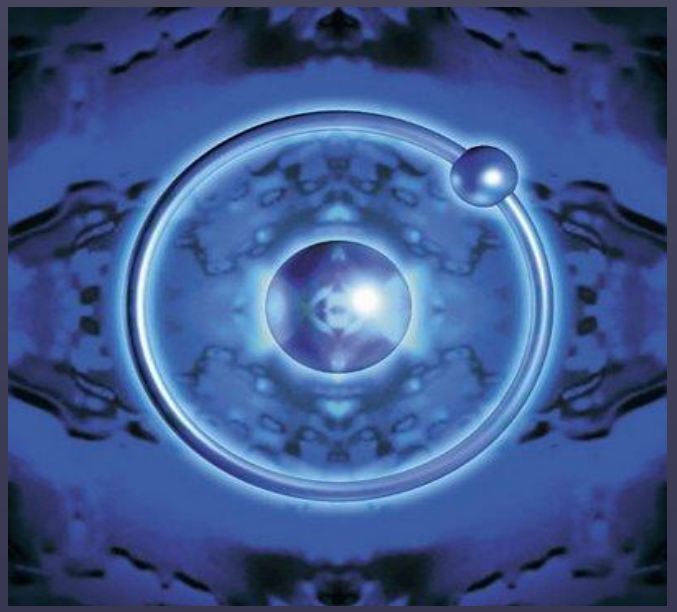


Transistors

- Logic gates are built by transistors

- First transistor: $\sim 1 \times 10^{-2}$ m
- Today's transistor: $\sim 5 \times 10^{-8}$ m
- Hydrogen atom: $\sim 5 \times 10^{-11}$ m

- What is the limit?

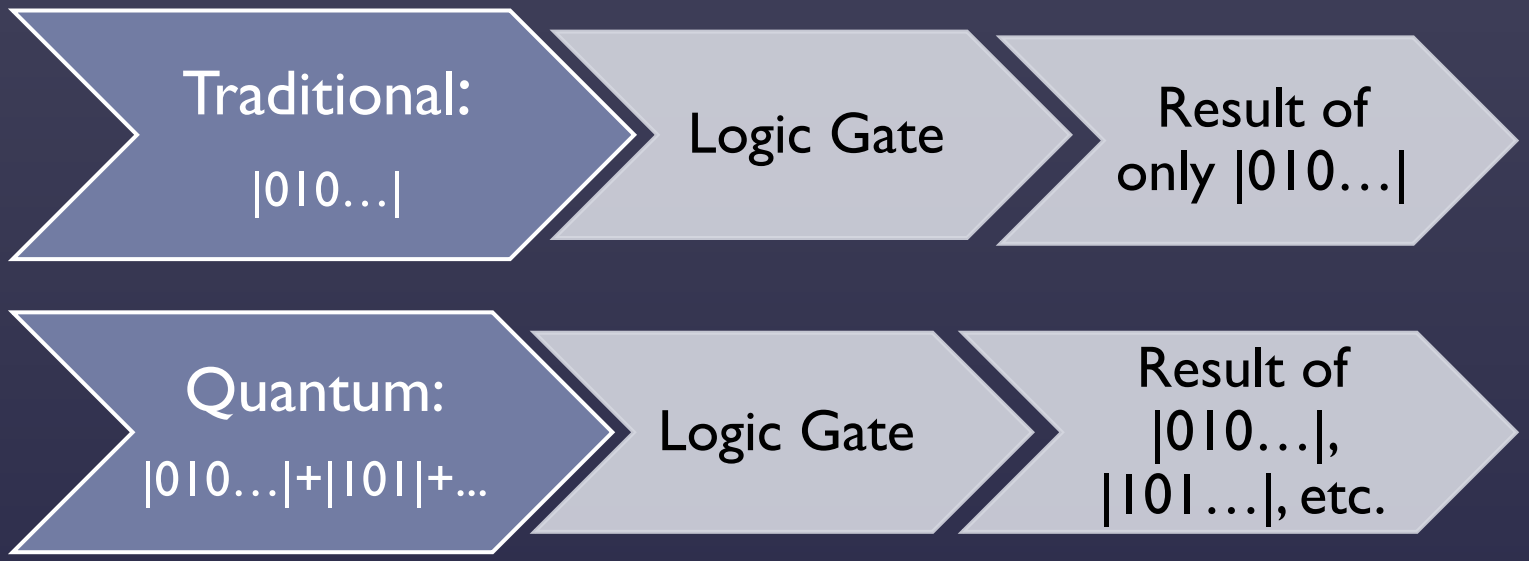


Why quantum computers?

- Transistors have **limited sizes**, and generate a lot of heat
- If we want really awesome super iPads, quantum computers are the way to go

How do quantum computers work?

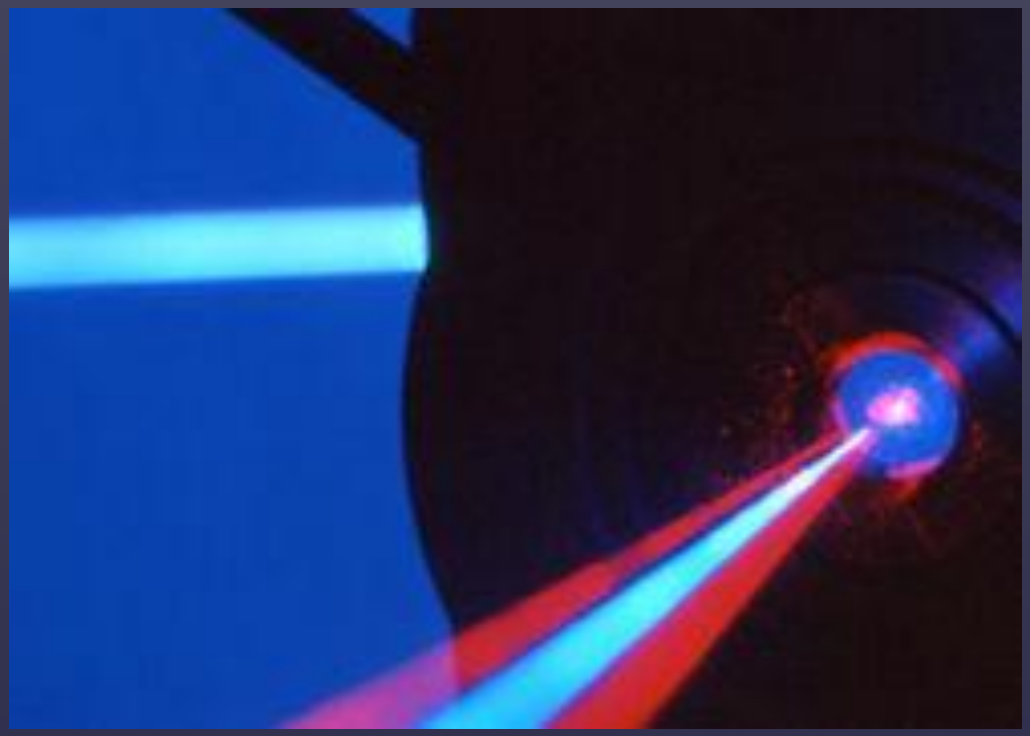
- Quantum computers compute on individual atoms
- We store information on **qubits**
- The computer is in a **superposition** of the states it could be in
- Not 1 OR 0 but both 1 AND 0



- Small print: all results except one is destroyed upon measuring the system.

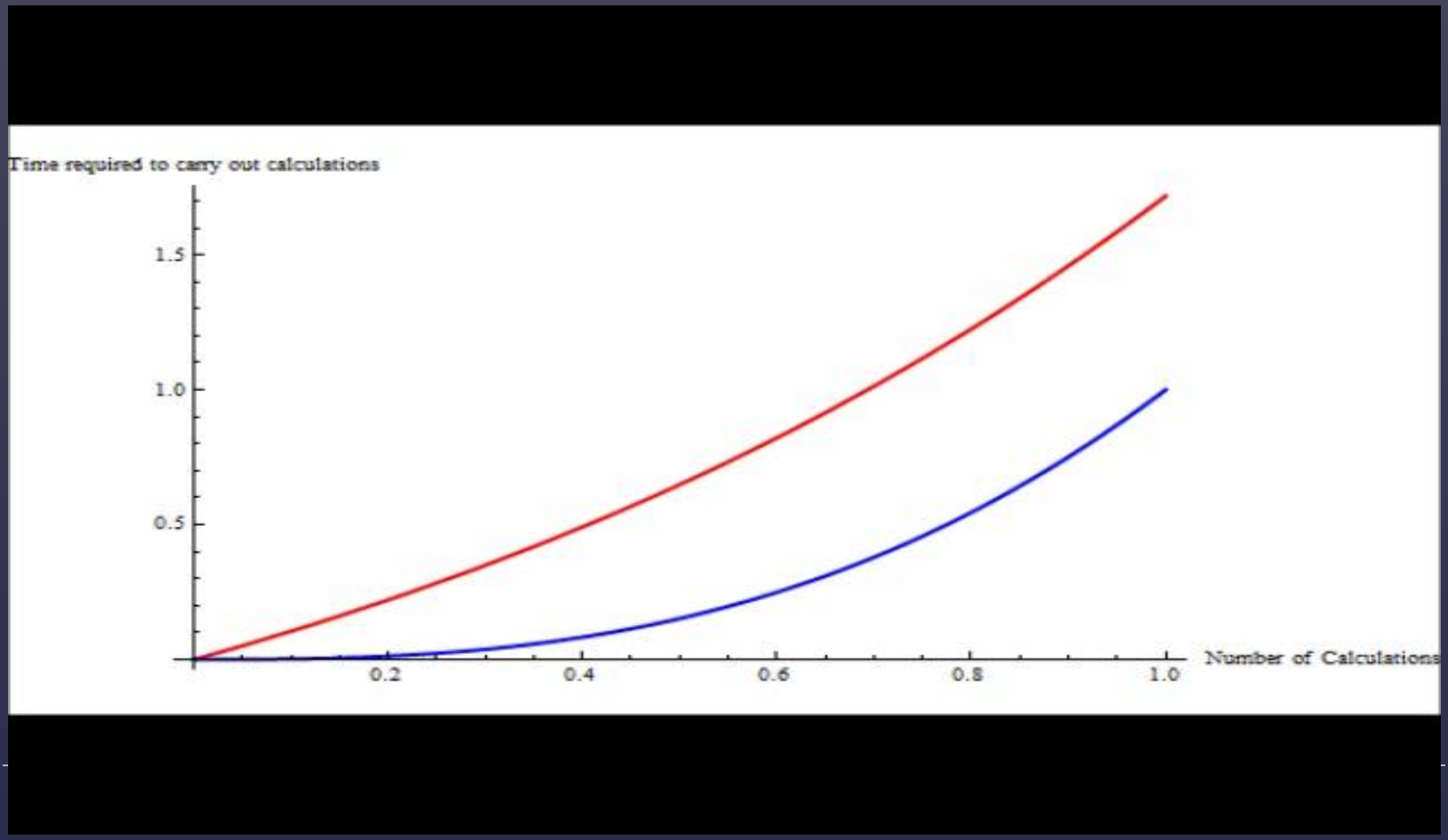
Quantum logic gates

- Can be implemented by spectroscopic techniques
- Example: Shooting laser pulses at an atom



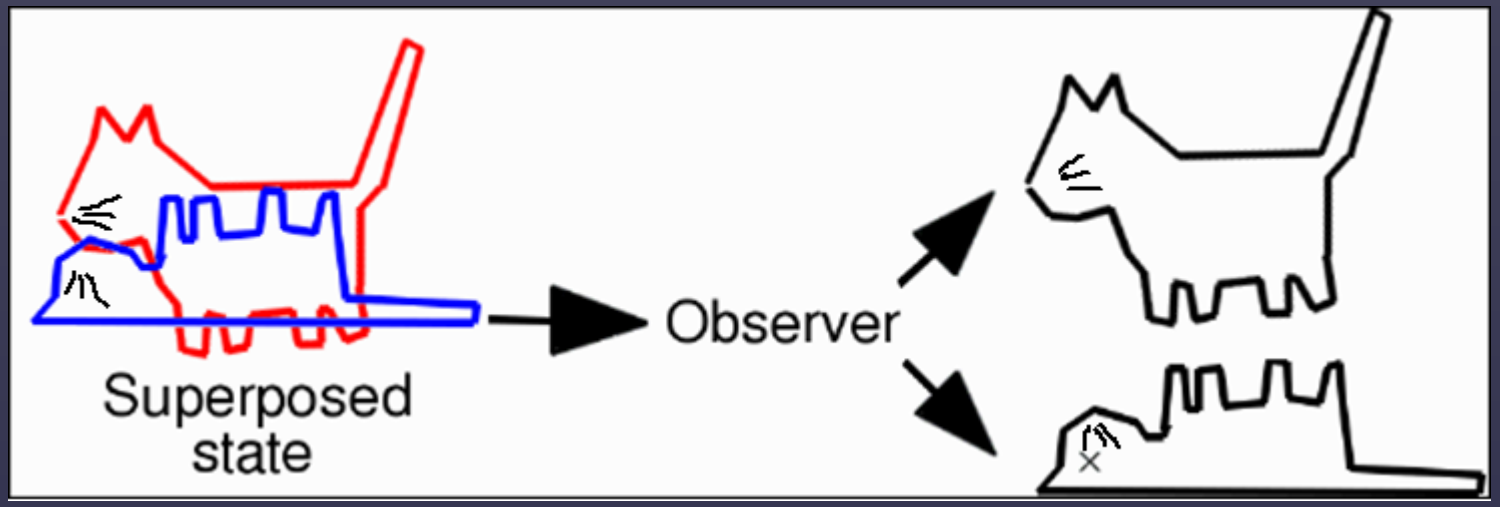
What can we do with quantum computers?

- Shor's Factorization Algorithm
- Allows quick calculations of prime factors



Issues in constructing a quantum computer

- Quantum systems are fragile
- Systems could become **decoherent**



What are quantum computers good for?

- Artificial intelligence
- Further research validity of quantum theory
- Really, really awesome apple products

Thanks for listening!