Nicola Davis The Observer, Thursday 6 March 2014 06.59 GMT

Source: http://www.theguardian.com/science/2014/mar/06/quantum-computing-explained-particle-mechanics

Quantum computing explained:

Harnessing particle physics to work faster. Work is underway around the world to revolutionize computers using the principles of quantum mechanics.

Around the world teams of scientists are working on the next technological revolution: quantum computing.

But what makes it so special?

And why do we need it?

We ask physicist Dr Ruth Oulton of the Bristol University to explain.

A] .....

A normal computer has bits and each bit is either zero or one. A quantum computer has quantum bits. These are made out of quantum particles that can be zero, one, or some kind of state in between – in other words they can have both values at the same time.

B] .....

It pretty much could be any **fundamental** particle, so it could be a photon or an electron or it could be a nucleus, for example. It's a particle that can have two different properties at once. For example, the particle can be in both one place and the other place at the same time.

C] .....In a normal computer, a particular calculation might go through all the different possibilities of zeros and ones for a particular calculation. Because a quantum computer can be in all the states at the same time, you just do one calculation testing a vast number of possibilities **simultaneously**. So it can be much quicker.

D] .....
You need a very good control over individual particles. You can't just **shove** all the particles together because they would interact with each other in an unpredictable way. You need to be able to trap and direct them, but when the particles interact with the trap itself it makes them lose their information, so you need to make sure that you design the trap well.

E] .....
The biggest and most important one is the ability to **factorise** a very large number into two prime numbers. That's really important because that's what almost all encryption for internet computing is based on. A quantum computer should be able to do that relatively quickly to get back the prime numbers and that will mean that basically anything that has been with that encryption can be de-encrypted. If you were to do it with the classical computers we have now, it would take longer than the age of the universe to go back.

F] .....
Calculating the positions of individual atoms in very large molecules like polymers and in viruses. The way that the particles interact with each other – there's so many different possibilities that normally they say that you can't calculate anything properly with more than about 10 atoms inside the molecule. So if you have a quantum computer you could use it to develop drugs and understand how molecules work a bit better.

G] .....
There is a commercial computer out there but it's very expensive ($10m), it has very limited computing power and it hasn't yet been verified by anybody externally [as to] what it's actually doing.

H] .....
We are completely re-designing the computer. The very first quantum computers will probably fill a room. It's going to take us a while to get to desktops. Really, actually what is going to happen is you are going to have a hybrid laptop with a quantum chip and a classical chip.

Activity 1: Match the titles with the paragraphs

..... Are there other scientific uses?
..... In a normal computer, information is stored as bits. How is it different in a quantum computer
..... Will quantum computers look like our desktops and laptops do now?
..... So a quantum bit is made from a physical particle?
..... Are there commercial quantum computers?
..... How does this help with computing?
..... What are the applications?
..... What's the biggest challenge?

Activity 2:Comprehension Questions

1) What's the difference between bits and qubits? .....

2)What's the potential advantage of a quantum computer.....

3) What can a faster computer be useful for? .....

Activity 3:Match the highlighted words with the following synonyms or phrases.

1. basic = ...
2. controlling = ...
3. at the same time = ...
4. push with force = ...
5. to resolve into factors (maths) = ...

*