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The quantum computer draws closer

Scientists have “entangled” two sub-atomic **1)**_____ separated by about a millimetre, an achievement that might pave the way for powerful quantum computers in the future. Entangled particles may be useful for making logic **2)**_____ for computers that have a far greater capacity and speed than today’s machines. The work, published in the journal Science, represents the latest advance in a broad scientific effort to apply properties of quantum physics to the creation of a new generation of supercomputers.

Quantum entanglement (QE) describes a situation in which the fates of two or more particles become bound together. When two particles are entangled, they are in some way connected, because the fate of one depends upon the other, no matter how far apart they are. A change in one entangled particle results in an instant change in the other particle or particles, **3)**_____ of the distance separating them – even if they are at opposite ends of the Universe. To many people, this sounds “weird”, and even Einstein never quite came to terms with it.

Of course, it is not quite as simple as the statement makes it seem. The phenomenon is linked in a deep way to the **4)**_____ properties of matter and the nature of observing and measuring reality. For this reason, it really troubled Einstein, especially since the concept **5)**_____ that a change in one particle is somehow communicated to the other faster than the speed of light, which is generally regarded as nature’s “**6)**_____ speed limit”.

Einstein called it “spooky action at a distance”. He believed there was something **7)**_____ in the phenomenon, and that buried in its seeming absurdity lay something that could overthrow quantum mechanics, the present most successful theory of the way the Universe behaves on the atomic and sub-atomic level.

Einstein was no longer alive when, in the 1970s, the physicist Alan Aspect carried out an experiment that showed QE was real and could form the basis for the computers, if not of tomorrow, then of the day after tomorrow. Today’s computers are limited by the speed of electrons as they move around integrated circuits. In the future, computers that use light instead of electrons will be faster. However, even the speed of light may be **8)**_____ because of the curious properties of entanglement. According to some, a computer based on quantum entanglement would not be **9)**_____ by speed limits of this kind as it would use “spooky action at a distance” instead of electrons or photons.

A quantum computer would have to “entangle” quantum bits – or qubits – over significant distances. However, prior to the latest research particle entanglement had only been **10)**_____ on the micrometre (millionth of a metre) scale. Now, Andrew Berkley and colleagues from the University of Maryland have entangled two qubits inside a silicon chip over a distance of 0.7 millimetres – a thousand times greater. While a millimetre does not sound like the opposite end of the Universe, it is significantly closer to the scale needed to build quantum mechanical computer components.

Entanglement is essential to quantum computing because it is the linked quality that builds more information into quantum bits than is possible with classical computing bits. The current advance, which has built on the work of many others in the field, has moved information technology further along the road towards a quantum computer.

Vocabulary

Select the correct alternative to fill in the numbered gaps in the text

1	a) electrons	b) photons	**c) particles**	d) neutrons
2	a) circles	**b) circuits**	c) cebits	d) circuses
3	**a) regardless**	b) according	c) because	d) regarding
4	a) foundation	b) fundamentalist	**c) fundamental**	d) founding
5	a) consists	b) declares	c) states	**d) implies**
6	a) frontier	b) final	c) fastest	**d) ultimate**
7	**a) absurd**	b) profound	c) mistaken	d) defined
8	a) destroyed	**b) supplanted**	c) abolished	d) reversed
9	a) possible	b) prevented	c) limited	**d) bound**
10	**a) observed**	b) watched	c) looked at	d) overlooked

Questions

1 How does distance affect the relationship of entangled particles to each other?
It doesn't. Distance play no role whatsoever.

2 How much time is needed for a change in one entangled particle to affect the other(s)?
The change happens instantaneously

3 Why did Einstein find the idea of communication faster than the speed of light troubling?
He couldn´t explain it, which is of course a problem for a scientist. Moreover, if this were true, it would turn his ideas on its head – up to now "the" accepted explanation for how the universe worked

4 Suggest an explanation of why Einstein used an unscientific term like "spooky" to describe quantum entanglement.
Maybe he was afraid of it; hence the use of supernatural which indicates that something is ghost-like or controlled by "other" powers.

5 What determines the greatest speed that can be achieved with current computer technology?
The speed of electrons is the dominant factor

6 What will probably be an intermediate stage between today's computers and a quantum computer?
The speed of light could be an intermediate stage

7 Why do the results of the research reported in the text represent such a significant advance?
It represents one-step nearer a quantum computer. Nowadays, we know that quantum computers do exist but it will be a very long time until they are commercially available if ever.

Quantum entanglement = Quantenverschränkung