Source:

Daily Mail AUSTRALIA

Quantum teleportation breakthrough as scientists send data across cities - and it could lead to UNBREAKABLE encryption for computer networks

http://www.dailymail.co.uk/sciencetech/article-3796640/Beam-Scotty-Star-Trek-like-travel-reality-scientists-manage-teleport-data-cities.html

Daily Mail AUSTRALIA

Quantum teleportation breakthrough as scientists send data across cities - and it could lead to UNBREAKABLE encryption for computer networks

- **Quantum teleportation involves sending quantum information using light**
- **State of a particle is destroyed at one location but imprinted on another**
- **Two separate studies have shown this is now feasible across several miles**
- **This new research is a step towards building a faster 'quantum Internet'**
- **The breakthrough could lead to more secure internet banking**

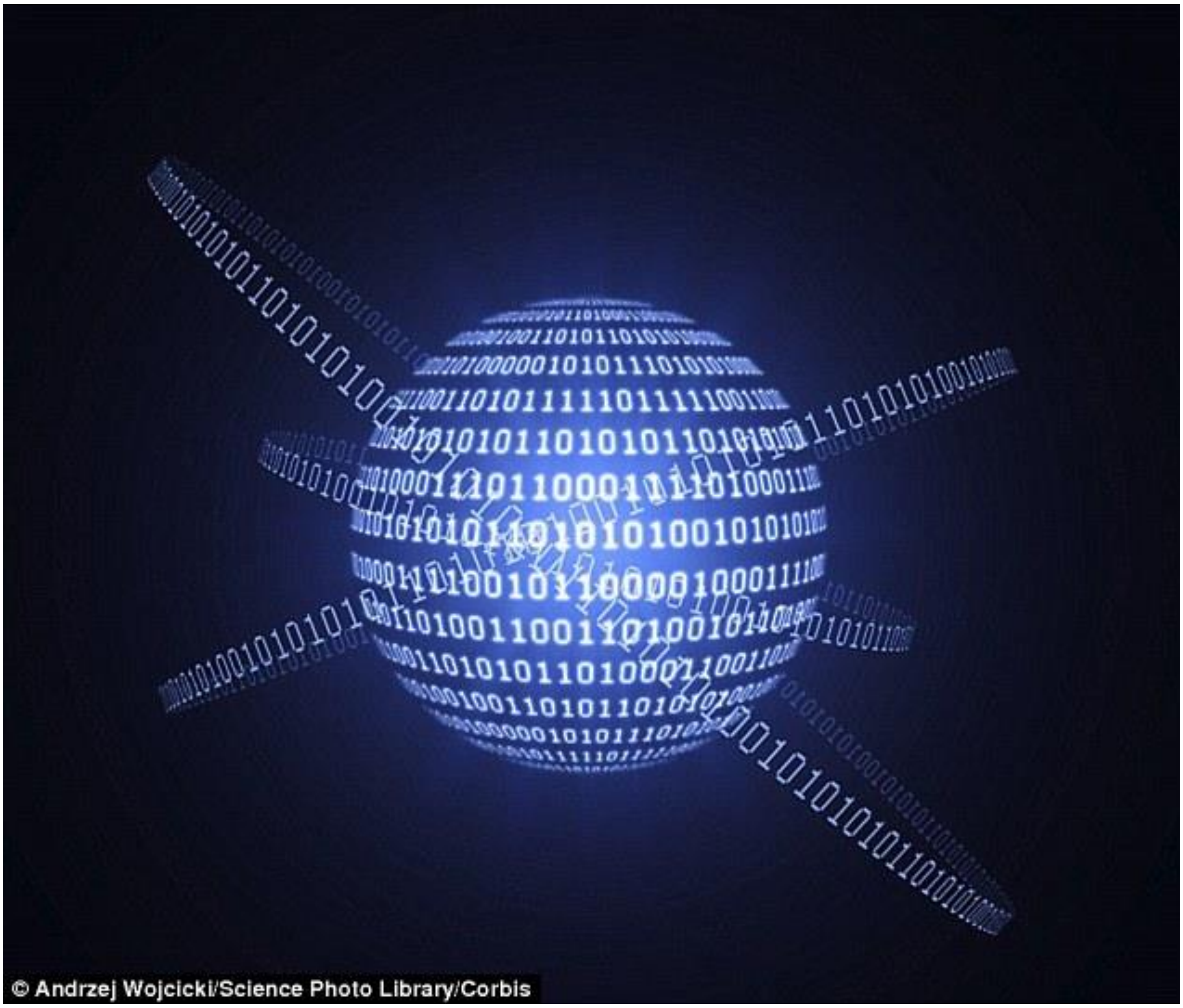
By ABIGAIL BEALL FOR MAILONLINE
PUBLISHED: 01:00 +10:00, 20 September 2016 | **UPDATED:** 17:49 +10:00, 20 September 2016

While Star Trek-style teleportation is still a long way off, researchers have revealed a major breakthrough in the field of quantum travel.

Two separate teams have transferred quantum information over several miles of fibre optic networks in an urban network.

The results could lead to more secure bank accounts, a faster internet and possibly even open the door to the controversial idea of human teleportation.

Scroll down for video



One of the potential applications for quantum teleportation is a network of quantum computers (illustrated) and a 'quantum internet' that is far faster and much more secure than current networks

---

WHAT IS ENTANGLEMENT?

When atoms are 'entangled' the measurement of one of the atoms will not only cause it to 'pick' one state, but it will also instantaneously cause the atoms it is entangled with to do the same, even if that atom has not been measured itself.

This means we automatically know information about all the atoms that are entangled at once, just by measuring one, and it does not matter how far apart in space the two entangled atoms are.

This strange concept is at the heart of quantum computing and the source of the potential speed up of a quantum computer compared to a classical computer for certain algorithms.

Quantum teleportation depends on a phenomenon called quantum entanglement, which allows connections to be made between atoms, with their information being sent to others far away.

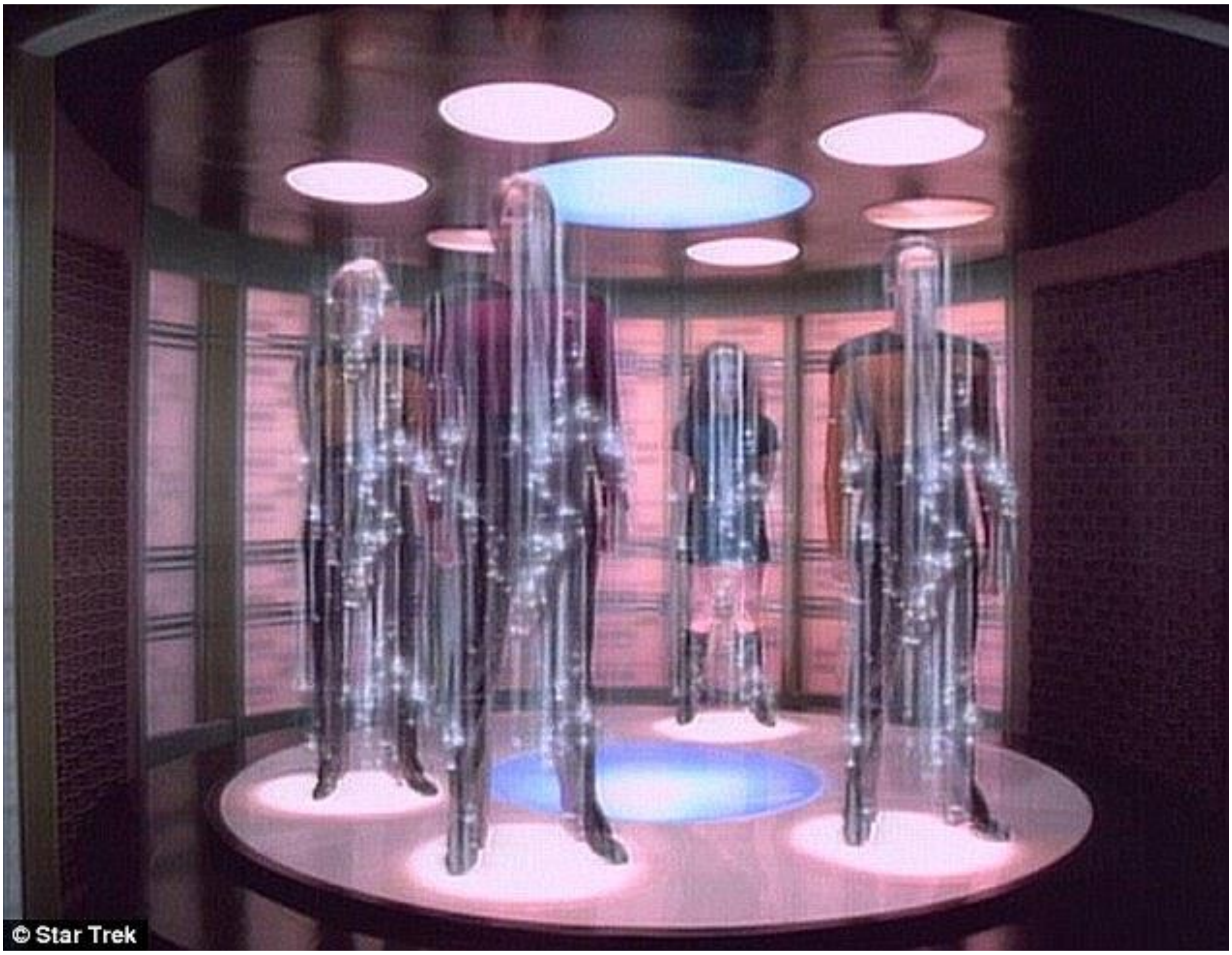
The entangled particles are connected in such a way that the action of one directly affects the others, even if they are separated over large distances.

Albert Einstein called this 'spooky action at a distance.'

Previous studies have shown atoms teleporting across a room, and light being teleported across the Danube River in Austria.

Now two separate studies, published today in Nature Photonics, have shown quantum teleportation is feasible through optical fibres across cities.

The new research is a step towards building a 'quantum internet', which would be faster, more efficient and more secure than the networks we rely on today.



Human teleportation was a feature seen in Star Trek (pictured). Some experts have said breakthroughs in quantum teleportation could eventually lead to human teleportation

Quantum teleportation seems like science fiction in the sense that the state of a particle is destroyed at one location but imprinted on another remote system - without the two particles ever interacting.

Long-distance quantum teleportation using a fibre network is more secure than through the air, but it requires independent light sources, and this presents a technological challenge.

The light beam from one source needs to stay indistinguishable to the light beam from the other source after travelling through several miles of fibre.

In **one study,** researchers from the University of Science and Technology of China in Shanghai demonstrated the effect over optical fibres in Hefei, China.

HOW QUANTUM TELEPORTATION WORKS

How quantum teleportation works is complicated, but an analogy for the principle behind it may help.

Let's say there are two people, Alice and Bob. Alice wants Bob to have a photon that's in the same 'state' as her photon, which we'll call photon P.

For the sake of this analogy, we can pretend that the 'state' is a colour, and photon P is yellow.

A third person named Charlie sends out two entangled photons, photon A to Alice and photon B to Bob, which behave as if they are part of the same whole.

Both of these photons start out as blue.

Alice's two photons, P, which is yellow, and A, which is blue, 'collide.'

Alice measures the photons as they annihilate one another.

Although P and A are destroyed in the crash, P's yellow colour is preserved.

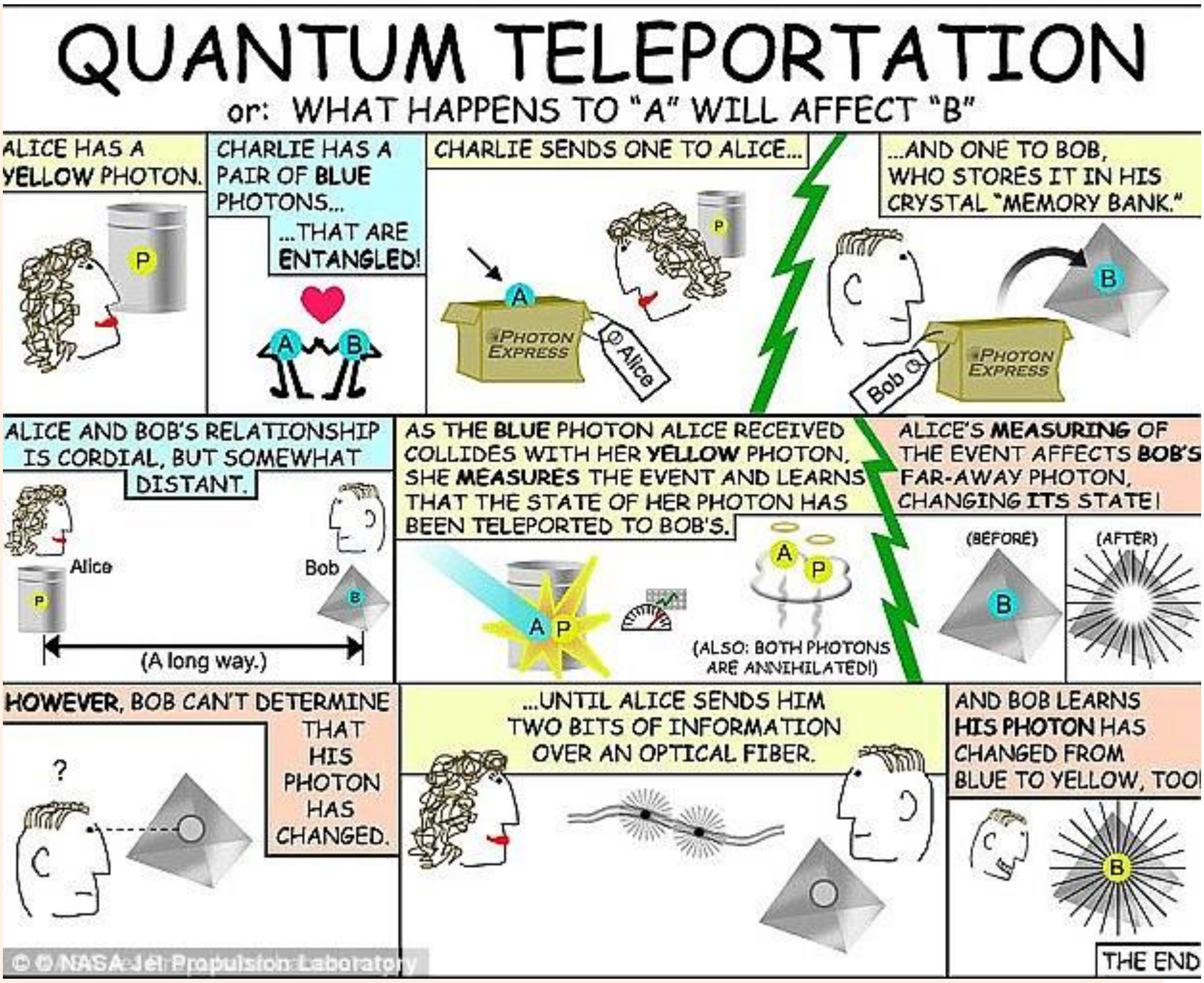
Because photon A and photon B are entangled, the yellow colour is 'teleported' to B.

But in order to get photon B to become yellow, as photon P originally was, Alice needs to send Bob two bits of information to B the 'classical' way - for example, by sending pulses of light over an optical fibre.

When Alice measures the state of her photon, Bob's photon changes state as well, as if flipping a switch.

But Bob cannot know how the switch flipped unless Alice sends him the bits of information classically.

Bob does not know that his photon has changed to yellow without that additional information.



+4

This Nasa cartoon demonstrates the principle of quantum teleportation using an analogy. Alice wants Bob to have a photon that's in the same 'state' as her photon

In the **second**, researchers from the University of Calgary designed another set-up to demonstrate the effect in Calgary, Canada.
Each of these experiments is split over three distinct locations, traditionally named Alice, Charlie and Bob, to mimic the structure of future quantum networks.

The two experiments separately demonstrated using optical fibres for quantum teleportation is possible across the length of cities.

The Calgary study was able to demonstrate the effect across an urban fibre network measuring 3.8 miles (6.2km).

In theory, the technique could be scaled up to work across any distance, which could lead to the development of a fibre-based quantum internet connecting major cities.

'Combined, these two experiments clearly show that teleportation across metropolitan distances is technologically feasible, and undoubtedly many interesting quantum information experiments in the future will be built on this work,' said Frederic Grosshans, writing in an accompanying Nature article.

Grosshans, a researcher in quantum computing at the National Centre for Scientific Research in Paris, was not involved in the research.

Quantum mechanics: a particle two states at the same time?

Loaded: 0%

Progress: 0%

0:00

Previous

Play

Skip

Mute

Current Time0:00

/

Duration Time6:05

Fullscreen

Need Text

WILL IT EVER BE POSSIBLE TO TELEPORT HUMANS?

Critics have argued there are too many atoms in the human body to translate into physical data, teleport and then re-arrange in order.

There is also the argument that in order to transport a living object, it would have to effectively die and come back to life.

But Professor Michio Kaku has previously said the breakthroughs needed to transport humans instantly have already been made.

He believes a teleporter could become a reality as soon as the end of the century and it's only a matter of time before we will be 'beaming' across the universe.

The physicist is a professor at City University in New York.

The results of the two papers could have implications for cryptography, which involves transmitting information securely, including communications between Earth and spacecraft.

For example, if Nasa is communicating with astronauts on Mars, it will not want to have hackers break the encrypted channel and give them false information.

Quantum teleportation can also be used to make systems such as bank accounts more secure over longer distances.

'Undoubtedly many interesting quantum information experiments in the future will be built on this work,' said Grosshans.

'For the longer term, the two papers demonstrate that the possibility of quantum networks that span a city are a realistic proposition, which is an exciting vision for the future.'

'A relatively near term application would be some variety of quantum cryptography,' Grosshans told MailOnline.

'Allowing communications secure against future technical progress, the messages cannot be recorder and decrypted by a powerful computer in the future.

'I can imagine this kind of applications be used in 10 to 20 years or never, depending on the evolution of classical cryptography and the research on quantum computer.'

One possible result of this research is human teleportation.

Professor Michio Kaku (pictured) has previously said the breakthroughs needed to transport humans instantly have already been made. He believes a teleporter could become a reality as soon as the end of the century

Professor Michio Kaku has previously said the breakthroughs needed to transport humans instantly have already been made.

He believes a teleporter could become a reality as soon as the end of the century and it's only a matter of time before we will be 'beaming' across the universe.

The physicist is a professor at City University in New York.

'You know the expression "Beam me up Scotty"? We used to laugh at it,' he said.

'We used to laugh when someone talked about teleportation, but we don't laugh anymore.'

'Quantum teleportation already exists [and] I think within a decade we will teleport the first molecule.'

He continued that, as humans we already do this at an atomic level, **reports** The Express.

Once scientists have successfully teleported molecules, Dr Kaku believes the next step will be to send photons to a lunar base before experimenting with larger objects, animals and eventually humans.