Longer distance quantum teleportation achieved

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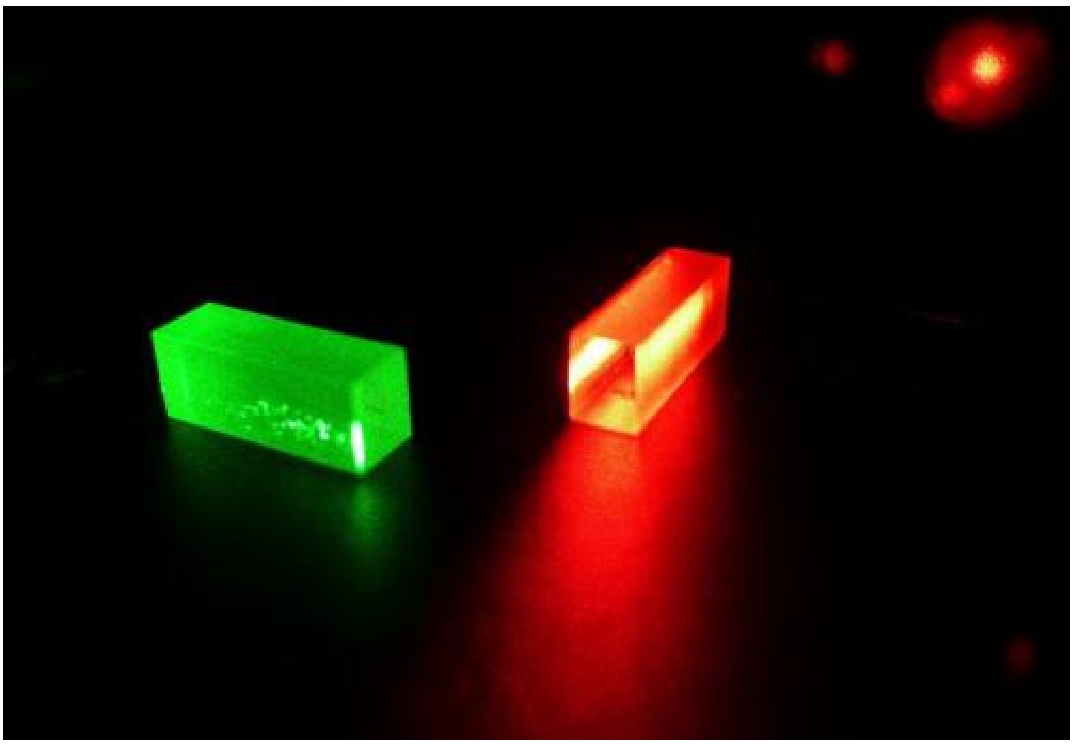

Crystals which contain photonic information after the teleportation. Credit: © GAP, University of Geneva (UNIGE)

Physicists at the University of Geneva have succeeded in teleporting the quantum state of a photon to a crystal over 25 kilometers of optical fiber.

The experiment, carried out in the laboratory of Professor Nicolas Gisin, constitutes a first, and simply pulverises the previous record of 6 kilometres achieved ten years ago by the same UNIGE team. Passing from light into matter, using teleportation of a photon to a crystal, shows that, in quantum physics, it is not the composition of a particle which is important, but rather its state, since this can exist and persist outside such extreme differences as those which distinguish light from matter. The results obtained by Félix Bussières and his colleagues are reported in the latest edition of *Nature Photonics*.

Quantum physics, and with it the UNIGE, is again being talked about around the world with the Marcel Benoist Prize for 2014 being awarded to Professor Nicolas Gisin, and the publication of experiments in *Nature Photonics*. The latest experiments have enabled verifying that the quantum state of a photon can be maintained whilst transporting it into a crystal without the two coming directly into contact. One needs to imagine the crystal as a memory bank for storing the photon's information; the latter is transferred over these distances using the teleportation effect.

Teleporting Over 25 Kilometres

The experiment not only represents a significant technological achievement but also a spectacular advance in the continually surprising possibilities afforded by the quantum dimension. By taking the distance to 25 kilometres of optical fibre, the UNIGE physicists have significantly surpassed their own record of 6 kilometres, the distance achieved during the first long-distance teleportation achieved by Professor Gisin and his team in 2003.

Memory After Triangulation

So what exactly is this testing of quantum entaglement and its properties? One needs to imagine two entangled photons -in other words two photons inextricably linked at the most infinitesimal level by their joint states. One is propelled along an optical fibre (the 25 kilometres mentioned earlier), but not the other, which is sent to a crystal. It is a bit like a game of billiards, with a third photon hitting the first which obliterates both of them. Scientists measure this collision. But the information contained in the third photon is not destroyed -on the contrary it finds its way to the crystal which also contains the second entangled photon.

Thus, as Félix Bussières the lead author of this publication explains, one observes "that the quantum state of the two elements of light, these two entangled photons which are like two Siamese twins, is a channel that empowers the teleportation from light into matter".

From there, it is a small step to conclude that, in quantum physics, the state takes precedence over the 'vehicle' - in other words an item's quantum properties transcend classical physical properties. A step that maybe now one can take.

More information: Quantum teleportation from a telecom-wavelength photon to a solid-state quantum memory, *Nature Photonics*, DOI: 10.1038/nphoton.2014.215

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