Chinese group breaks distance record for teleporting qubits

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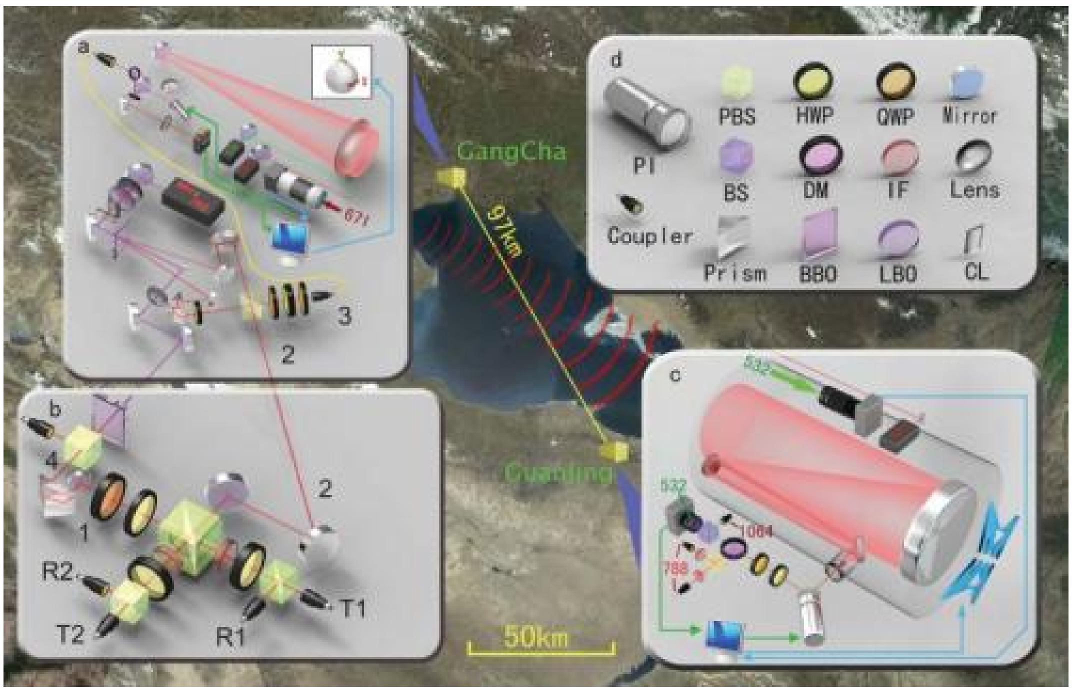

Bird's-eye view and schematic diagram for free-space quantum teleportation. Image from: http://arxiv.org/abs/1205.2024

(Phys.org) -- A team of Chinese physicists has broken the distance record for teleporting qubits, extending it from 16 to 97 kilometers. They did so, as they explain in their paper uploaded to the preprint server *arXiv*, using the phenomenon known as entanglement.

In this context, teleportation is used to denote the exchange of information describing the states of two separate entities without having to move any actual information through the space between them. It's important to note that teleportation in this context does not imply that an object is actually moved from one place to another, or disassociated and re-associated as seen in Star Trek, etc.

Entanglement is where two participles are entangled, i.e. connected in a way that physicists still cannot explain, though it can be shown that whatever happens to one, happens automatically and instantaneously, to the other. Thus, if one of a pair of entangled particles were made to represent one element of a stream of data that comprised a single letter of the alphabet, for example, the other would take on that value as well, allowing for instant communication; one that would also offer a means of communicating free from the worry of eavesdropping.

Unfortunately, there is still the problem of creating the pair with distance between them; that's the part that has been difficult, and it's the part that this new Chinese team has found a new way to increase. They used a 1.3-watt laser and some optic tricks to cause a pair of entangled photons to appear at two separate locations (across a lake from one another) at the same time, and then used a classical channel to measure the results.

In so doing the team showed that it might be possible to create a system using teleportation for communication purposes, based on communications through the air, to special satellites. Doing so would have two very significant advantages over conventional systems. The first, and most obvious would be to allow for nearly perfect cryptography applications. The second would be communications free from latency lags.

There is still a long way to go however, as the Chinese team has also demonstrated - their efforts still required the use of a classical channel to measure the results. Having to do so nullifies the latency lag effect and doesn't allow for teleporting whole messages, though it should allow for sending such messages through a classical channel while sending encryption keys via teleportation.

More information: Teleporting independent qubits through a 97 km free-space channel, arXiv:1205.2024v1 [quant-ph]
arxiv.org/abs/1205.2024

Abstract
With the help of quantum entanglement, quantum communication can be achieved between arbitrarily distant places without passing through intermediate locations by quantum teleportation. In the laboratory, quantum teleportation has been demonstrated over short distance by photonic and atomic qubits. Using fiber links, quantum teleportation has been achieved over kilometer distances. Long distance quantum teleportation is of particular interest and has been one of the holy grails of practical quantum communication. Most recently, quantum teleportation over 16 km free-space link was demonstrated. However, a major restriction in this experiment is that the unknown quantum state cannot directly come from outside. Here, based on an ultra-bright multi-photon entanglement source, we demonstrate quantum teleportation, closely following the original scheme, for any unknown state created outside, between two optical free-space links separated by 97 km. Over a 35-53 dB high-loss quantum channel, an average fidelity of 80.4(9) % is achieved for six distinct initial states. Besides being of fundamental interest, our result represents an important step towards a global quantum network. Moreover, the high-frequency and high-accuracy acquiring, pointing and tracking (APT) technique developed in our experiment can be directly utilized for future satellite-based quantum communication.