Chinese team builds first quantum router

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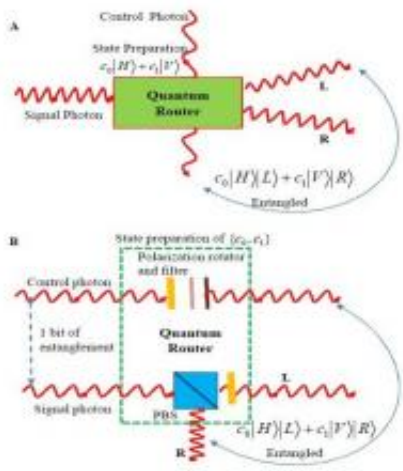

(A) Illustration of a genuine quantum router. The control photon can be in arbitrary superposition states with coe□cients c0; c1 that determine the path of the signal photon. (B) The entanglement-based approach to implementation of a genuine quantum router. With a bit of pre-shared entanglement, the quantum router can be realized with linear optical devices. The control coe□cients c0; c1 are imprinted through operation on the control photon alone with a polarization rotator and a lter. The routing is realized with a polarization beam splitter (PBS) and a wave plate on the signal photon. Image from arXiv:1207.7265v1 [quant-ph]

(Phys.org) -- With all the talk of quantum computers, little notice has been made of work on what is known as a quantum Internet, which is where data is sent across a web of computers via devices that work at the quantum, rather than atomic level, thereby increasing the speed of the whole system. The holdup at this point is in creating devices capable of

routing such information. Now it appears that a team of physicists working from Tsinghau University in China have proven that it's possible to do so. They have, as they describe in the paper they've uploaded to the preprint server *arXiv*, built a working quantum router capable of routing one cubit.

The trick in routing quantum data is that reading the information from a signal that tells a router where to send data, causes that data or signal to be destroyed; that's just how quantum mechanics works, so the ordinary way of routing data on a network won't work. To get around that problem, the researchers used two of the special properties of quantum particles, namely, entanglement, whereby whatever happens to one, automatically happens to another and the fact that a particle is capable of representing two states at once (i.e. both 1 and 0).

To build their router the team first generated a photon with superposition (one that has both horizontal and vertical polarization states); they then converted the photon to two entangled photons that also had superposition states. Then they treated one of the entangled pair as the control signal and the other as the data signal. When the control signal is read, and destroyed, the router gains the information it needs to know regarding which of two optical fiber cables to send the data signal, and thus, routes the data signal down the desired path.

The researchers aren't claiming they've come up with a solution for building a quantum Internet, as clearly their router is only capable of routing a single cubit, but it does demonstrate that routing quantum data is possible, and that's something that until now, no one else has been able to do. And it also gives hope to researchers that someday a new and different type of quantum router will be created that really will allow for a true quantum Internet, and if that happens, data transmission will likely become so fast, that it will cease to be a topic of conversation.

More information: Experimental demonstration of an entanglement-based quantum router, arXiv:1207.7265v1 [quant-ph] arxiv.org/abs/1207.7265

Abstract

We report an experiment that demonstrates full function of a quantum router using entangled photons, where the paths of a single-photon pulse are controlled in a coherent fashion by polarization of another single photon. Through a projective measurement, we prepare the polarization of the control photon in arbitrary superposition states, leading to coherent routing of the target photon in quantum superposition of different paths. We demonstrate quantum nature of this router through optical measurements based on quantum state tomography and show an average fidelity of $(93.24pm 0.23)%$ for the quantum routing operation.