Entanglement breaks new record

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Entanglement breaks new record
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Physicists have succeeded in entangling five photons for the first time. Although four photons have been entangled before, five is the minimum number needed for universal error correction in quantum computation. Moreover, the same team has demonstrated a process called "open−destination teleportation" for the first time (Z Zhao et al. 2004 Nature 430 54). The results represent a major breakthrough in efforts to exploit the laws of quantum mechanics in quantum information processing.

By taking advantage of quantum phenomena such as entanglement, teleportation and superposition, a quantum computer could, in principle, outperform a classical computer in certain computational tasks. Entanglement allows particles to have a much closer relationship than is possible in classical physics. For example, two photons can be entangled such that if one is horizontally polarized, the other is always vertically polarized, and vice versa, no matter how far apart they are. In quantum teleportation, complete information about the quantum state of a particle is instantaneously transferred by the sender, who is usually called Alice, to a receiver called Bob. Quantum superposition, meanwhile, allows a particle to be in two or more quantum states at the same time.

Jian−Wei Pan at the University of Heidelberg in Germany and colleagues at the University of Science and Technology of China in Hefei and the University of Innsbruck in Austria began by producing a high intensity and ultra−stable source of entangled photons. Next they used two entangled pairs of photons to generate a four−photon entangled state, which they then combined with a single−photon state. They were able to produce a five−photon entangled state by detecting the coincidence of five photons.

To demonstrate open−destination teleportation, Pan and co−workers first teleported the unknown quantum state of a single photon onto a superposition of three photons. They were then able to read out this teleported state at any one of the three photons by performing a measurement on the other two photons.

"Although our experiment might seem to be only a modest step forward, the implications are profound," Pan told PhysicsWeb. They plan to use their five−photon set−up to demonstrate "bit−flip error rejection" for quantum communication and to make a non−destructive controlled−NOT gate for quantum computation.

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