Building a better qubit: Combining 6 photons together results in highly robust qubits

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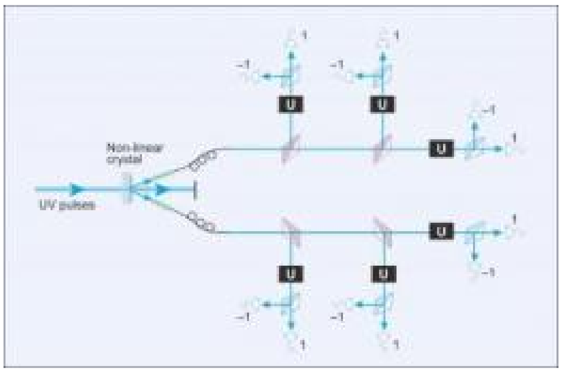

A new method for combining six photons together results in a highly robust qubit capable of transporting quantum information over long distances. Credit: Image courtesy of Carin Cain

Exploiting quantum mechanics for transmitting information is a tantalizing possibility because it promises secure, high speed communications. Unfortunately, the fragility of methods for storing and sending quantum information has so far frustrated the enterprise. Now a team of physicists in Sweden and Poland have shown that photons that encode data have strength in numbers. Their experiment is reported in *Physical Review Letters* and *Physical Review A* and highlighted in the October 5 issue of *Physics*.

In classical communications, a bit can represent one of two states - either 0 or 1. But because photons are quantum mechanical objects, they can exist in multiple states at the same time. Photons can also be combined, in a process known as entanglement, to store a bit of quantum information (i.e. a qubit).

Unlike data stored in a computer or typically sent through conventional fiber optic cables, however, qubits are extremely fragile. A kink in a cable, the properties of the cable material, or even changes in temperature can corrupt a qubit and destroy the information it carries. But now a group lead by Magnus RΙ′dmark at Stockholm University has shown that six entangled photons can encode information that stands up to some knocking around.

RΙ′dmark and his team proved experimentally that their six photon qubits are robust and should be able to reliably carry information over long distances. The technology to encode useful information on the qubits and subsequently read it back is still lacking, but once those problems are solved, we will be well on our way to secure, reliable, and speedy quantum communication.

More information:

• Experimental filtering of two-, four-, and six-photon singlets from a single parametric down-conversion source, Magnus RΙ′dmark, Marcin Wieśniak, Marek Żukowski, and Mohamed Bourennane, *Phys. Rev. A* 80, 040302 (2009) - Published October 05, 2009, Download PDF (free)

• Experimental Test of Fidelity Limits in Six-Photon Interferometry and of Rotational Invariance Properties of the Photonic Six-Qubit Entanglement Singlet State, Magnus RΙ′dmark, Marek Żukowski, and Mohamed Bourennane, *Phys. Rev. Lett.* 103, 150501 (2009) - Published October 05, 2009, Download PDF (free)

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