A way has been found to interconnect quantum devices including preserving entanglement

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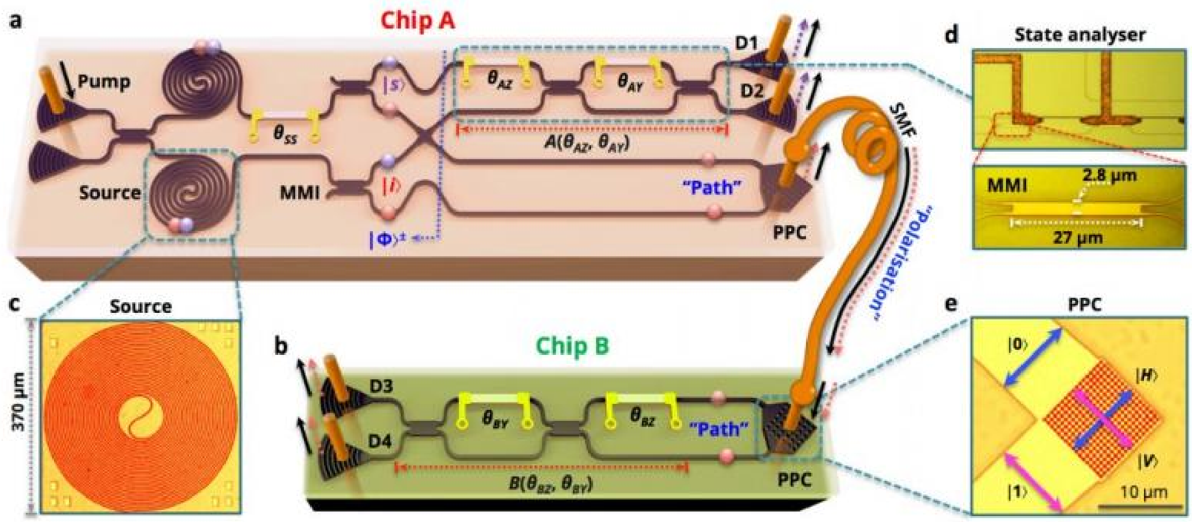

Quantum photonic interconnect and entanglement distribution between two integrated Si photonic chips. Credit: arXiv:1508.03214 [quant-ph]

(Phys.org)—An international team of researchers has found a way to interconnect two quantum devices, allowing photons to move between the two, all while preserving entanglement. In their paper they have uploaded to the preprint server *arXiv*, the team describes their process and their hopes for tweaking it to make it more efficient.

For modern electronic devices to work, there must be some channels for the different parts to use to convey information between them—such channels are usually either wire carrying electricity or fiber carrying photons and are called interconnects. But as researchers shrink down the parts, the interconnects more and more represent a bottleneck. Worse, as scientists conduct research into creating a truly quantum computer, the problem of creating interconnects for them has become a serious issue. Now, in this new effort, the research team is claiming to have found a solution—one where a separate entanglement stage is used to preserve the original entanglement needed as part of normal operations—demonstrating a way to connect two photonic chips.

To allow for interconnection, the researchers ran two sources of photons along one of the chips, on channels that overlapped—when the photons met in the overlap area, they became entangled and that entanglement was then carried along different paths in the chip. They next ran the photons through a device that converted that path entanglement into a whole new type of entanglement, one that involved polarization, which also caused the creation of new entangled photons. Those newly entangled polarized photons were then passed into an optical fiber that ran between the two chips. The whole process was then reversed in the second chip, where the polarized photons were converted back to path entangled photons, which then behaved exactly like the photons in the first chip. The team conducted multiple different types of tests to prove that entanglement was preserved throughout the interconnection process.

The team acknowledges that the process is still too inefficient to be implemented into real devices, but believe further refinement will lead to a usable solution. But, they have shown that it is possible to interconnect quantum devices, which should come as a relief to those working on building a quantum computer.

More information: Quantum Photonic Interconnect, arXiv:1508.03214 [quant-ph] arxiv.org/abs/1508.03214

Abstract
Integrated photonics has enabled much progress towards quantum technologies. However, many applications, e.g. quantum communication, sensing, and distributed and cloud quantum computing, require coherent photonic interconnection between separate sub-systems, with high-fidelity distribution and manipulation of entanglement between multiple devices being one of the most stringent requirements of the interconnected system. Coherently interconnecting separate chips is challenging due to the fragility of these quantum states and the demanding challenges of transmitting photons in at least two media within a single coherent system. Here, we report a quantum photonic interconnect demonstrating high-fidelity entanglement distribution and manipulation between two separate chips, implemented using state-of-the-art silicon photonics. Entangled states are generated and manipulated on-chip, and distributed between the chips by interconverting between path-encoding and polarisation-encoding. We use integrated state analysers to confirm a Bell-type violation of S=2.638+-0.039 between two chips. With improvements in loss, this quantum interconnect will provide new levels of flexible systems and architectures for quantum technologies.

via Arxiv Blog