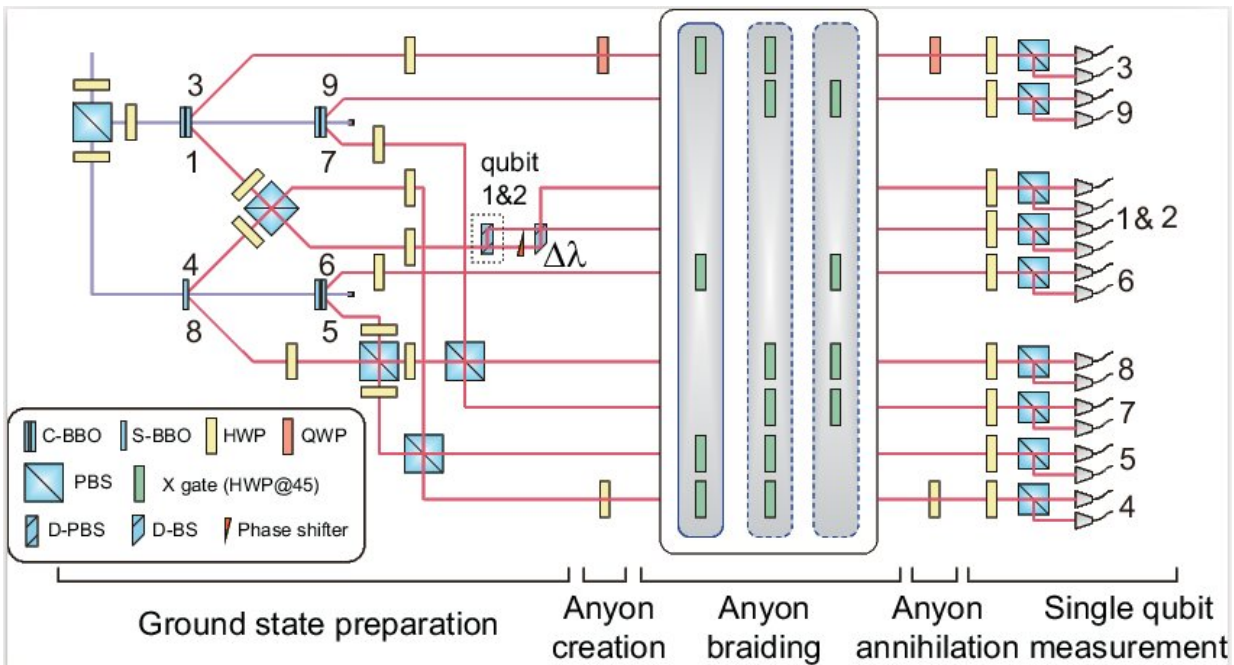


Optical toric code platform sets new record

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The experimental setup. Ultraviolet laser pulses with a central wave-length of 394 nm, pulse duration of 150 fs, and repetition rate of 80 MHz pass through three HWP-sandwiched BBO crystals and a single BBO to produce three entangled photon pairs (in spatial modes 1-3, 5-6, and 7-9) and a pair of photons (in spatial 4-8), respectively. All of these photons are put into a linear optical network to prepare the ground state. The steps of ground state preparation, anyon creation, anyon braiding, anyon annihilation, and measurement are marked. (C-BBO, sandwich-like BBO + HWP + BBO combination; S-BBO, single BBO; QWP, quarter-wave plate; HWP, half-wave plate; PBS, polarizing beam splitter; D-PBS, double PBS; D-BS, double beam splitter.) Credit: LIU Chang

Anyons form the basis for topological quantum computation and error correction, where the topological aspect of anyonic braiding is one of the important features that gives rise to fault tolerance. More qubits to control will assist researchers to explore further.

Recently, a research group led by professor Pan Jianwei and Lu Chaoyang of University of Science and Technology of China successfully designed the largest planar code platform at present using photons, and demonstrated path-independent property in optical system for the first time.

The group first generated the 8 entanglement photons using spontaneous parametric down-conversion and interference. One of the photons is encoded with polarization and path, eventually creating the 9 qubits anyons models.

Then, researchers performed braiding operations on the anyons. Thanks to more qubits, the platform contains enough lattices for demonstration of path-independent property. If two operations have topologically equivalent paths, phase offset of system will remain unchanged. By measuring this offset, path-independent property was observed in the system.

This work provides a [platform](#) for simulating the braiding operations with linear optics. Researchers are able to conduct more complicated experiments on the features of anyonic statistics in the future.

The result was published on *Optica*.

More information: Chang Liu et al, Demonstration of topologically path-independent anyonic braiding in a nine-qubit planar code, *Optica* (2019). [DOI: 10.1364/OPTICA.6.000264](https://doi.org/10.1364/OPTICA.6.000264)

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