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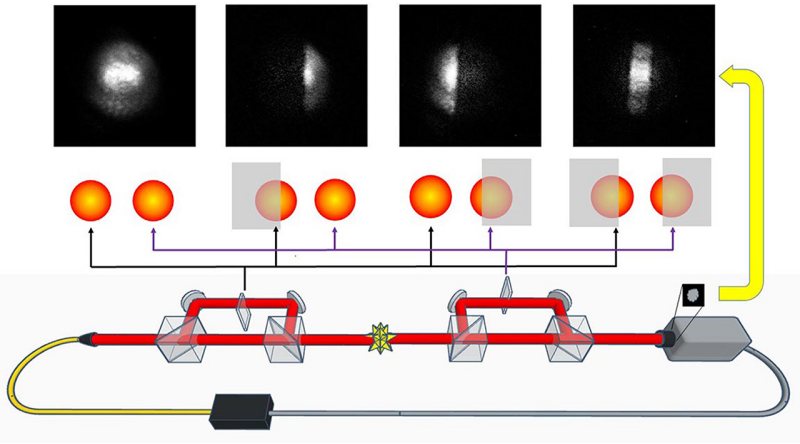
Franson interference has been used to demonstrate the nonlocal erasure and correction of an image of a phase object.



Franson interference (FI) is a fourth-order two-particle interference effect that does not require interaction between the particles and can be observed even when they are separated by large distances. This nonlocal property has led to the use of FI in quantum communications and testing the speed of "spooky action at a distance." As reported in a recent paper, FI has been used to remotely erase an object's image. The authors show it is possible to perform the erasure irrespective of the distance between the erasing and erased objects as long as entanglement is maintained between the two photons involved.

The experimental setup used in their demonstration incorporates FI into a quantum coincidence imaging system. A pair of polarization entangled photons are separated and sent through separate polarization interferometers (PI). One photon is detected by an avalanche photodiode, which then produces an electrical signal to trigger a camera to detect the other photon. Due to the specific polarization state of the photons, no interference is observed when the camera isn't triggered but emerges only when the photons are detected in coincidence. This is characteristic of FI.

Placing a transparent glass plate in the path of either photon inside the PI will disturb FI and reveal the glass plate's presence in the camera image. When an identical glass plate is placed in the PI of the partner photon, FI will be restored in the region, where the two glass plate images overlap, thus remotely erasing both glass plate images in the overlap region.

These results have potential applications in image corrections in quantum imaging and microscopy and might also be useful for security enhancement in quantum communications.

Source: "Nonlocal quantum erasure of phase objects," by Lu Gao, Yingwen Zhang, Eliahu Cohen, Avshalom C. Elitzur, and Ebrahim Karimi, *Applied Physics Letters* (2019). The article can be accessed at https://doi.org/10.1063/1.5108615.