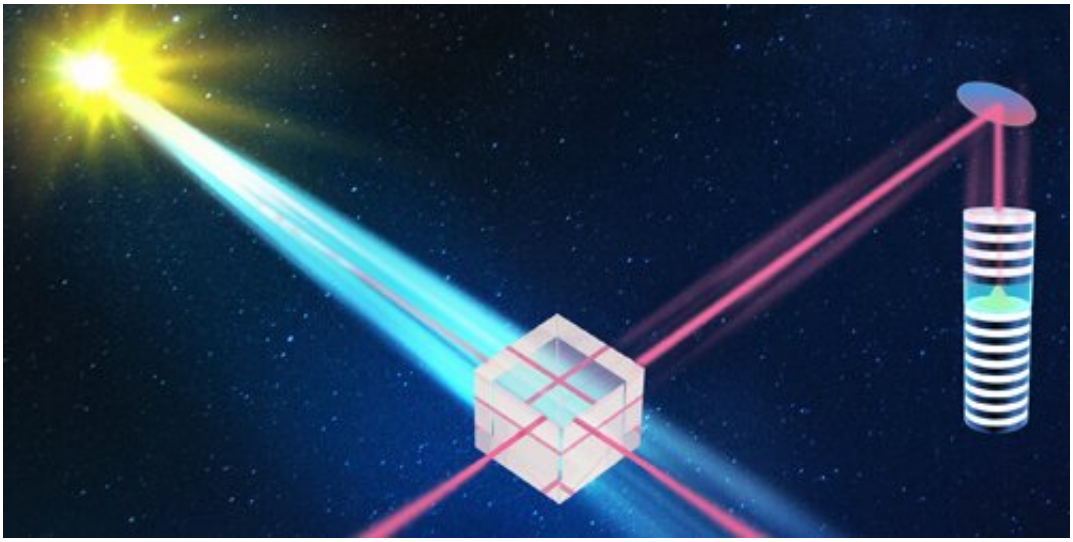
Entangling photons generated millions of miles apart

August 28 2019, by Bob Yirka



Credit: C.-Y. Lu and L.-C. Peng/HFNL

A team of researchers with members from China, Germany, the U.K. and the U.S. has found a way to entangle photons generated millions of miles apart. In their paper published in the journal *Physical Review Letters*, the researchers describe this feat and how it might be used to study properties of the sun.

Back in 1987, researchers found that two identical photons entering a beam splitter would always exit the splitter from the same port. Since they were not physically bonded to one another, logic suggested they should have emerged from separate ports approximately half the time.

Theory suggested the reason they did not was because of quantum interference. One notable property of the experiment was that it required that the two photons be generated on demand in order to time their arrival at the splitter. In this new effort, the researchers wondered if it might be possible to achieve the same effect with photons generated from an unpredictable source—the sun.

To find out if this was possible, the researchers set up a filter system for light arriving from the sun that would only admit photons that matched all the characteristics of one they generated locally on demand. But that still left a problem with timing—getting them to arrive at a splitter at the same time. To make this happen, the researchers directed the stream of photons from the first filter through yet another filter—one that filtered out those photons that were not arriving at the same rate as would the photon they generated themselves.

They turned the detector on and off at specified times, allowing entry only to those that arrived at the same times as those that were generated locally. The team reports that two identical photons from distant sources entered their splitter at the exact same time (with a few minor errors here and there). And as expected, the two photons exited the beam splitter from the same port. The researchers took the next logical step—they entangled the photons from the sun with photons they generated locally.

The researchers acknowledge that aside from the "cool" factor, their achievement may not lead to any immediate practical applications, but suggest it might help with conducting studies of photons from the sun.

More information: Yu-Hao Deng et al. Quantum Interference between Light Sources Separated by 150 Million Kilometers, *Physical Review Letters* (2019). DOI: 10.1103/PhysRevLett.123.080401 . On Arxiv: arxiv.org/abs/1905.02868

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