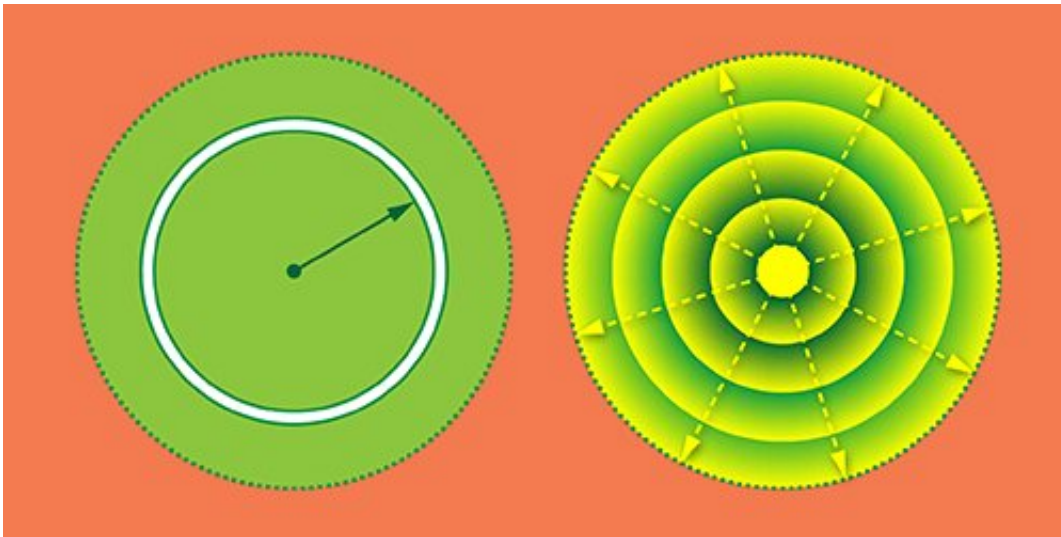


# Correlating entangled photons by radial position and momenta

August 22 2019, by Bob Yirka



Credit: L. Chen/Xiamen University

A team of researchers from Xiamen University, the University of Ottawa and the University of Rochester has shown that it is possible to entangle photons with correlations between their radial and momentum states. In their paper published in the journal *Physical Review Letters*, the group describes experiments they carried out with entangled photons and what they learned.

Entanglement has made headlines as scientists continue to study the "eerie" quantum-mechanical phenomenon. Such work has shown that different types of quantum particles can be entangled, and that photons,

in particular, can be entangled with correlations between such properties as polarization. In this new effort, the researchers have shown that entangled [photon](#) pairs can also be entangled with correlations between their radial positions and their radial momenta.

With photons, radial positions are their radii state and their radial momentum is a way of describing whether their ring is contracting or expanding. In this new effort, the researchers sought to learn whether it would be possible to correlate entangled photons using these two properties.

To find out, the researchers created a pair of entangled photons by firing a laser into a crystal—each of the entangled photons was then directed down a separate arm with two spatial light modulators. One of the modulators checked for correlations between radii, and the other one checked momentum. The modulators only allowed those of a predefined type to pass through—photons that were able to pass through were measured by detectors situated at the end of the arm. If both of the photons made it through the modulators, they were deemed to be entangled.

The researchers report that their experiments showed that photons can, indeed, be correlated by radial [position](#) and [momentum](#). They suggest their finding opens up the possibility of using entangled photons in new ways—such as to create specialized [optical tweezers](#) for applications such as moving trapped particles with more precision. They also suggest such entangled photons could be used to create new types of cryptography applications or as experimental tools used to test physics theories.

**More information:** Lixiang Chen et al. Realization of the Einstein-Podolsky-Rosen Paradox Using Radial Position and Radial Momentum Variables, *Physical Review Letters* (2019). [DOI](#):

[10.1103/PhysRevLett.123.060403](https://arxiv.org/abs/10.1103/PhysRevLett.123.060403)

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