New technique for creation of entangled photon states

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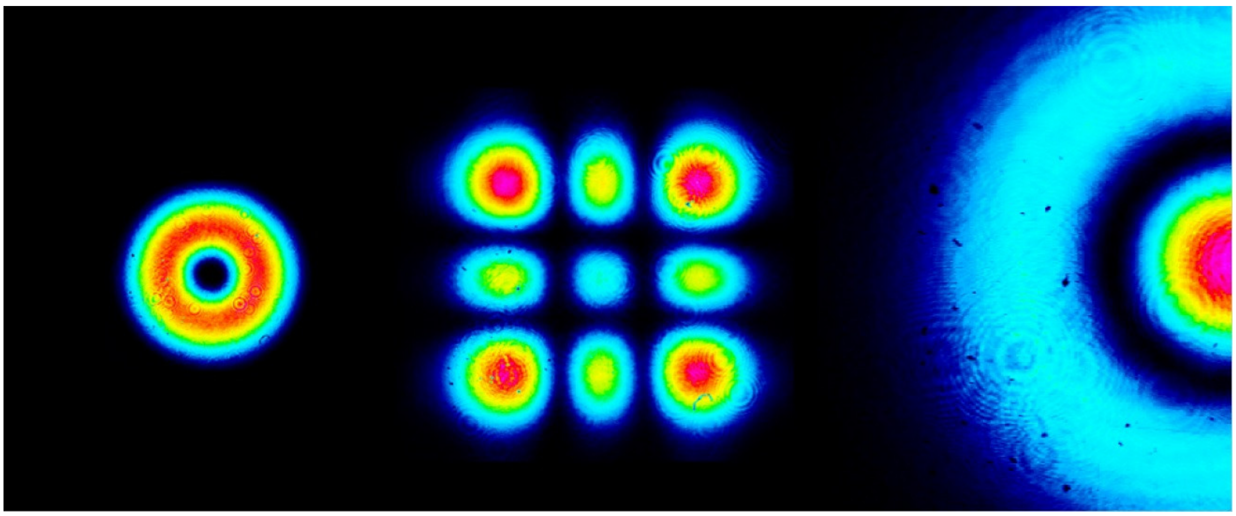

Photon beams. Photo was taken by CCD-matrix. Credit: Egor Kovlakov

Members of the Faculty of Physics at the Lomonosov Moscow State University have elaborated a new technique for creating entangled photon states. They have described their research in an article published in the journal *Physical Review Letters*.

Stanislav Straupe, Doctor of Sciences in Physics and Mathematics and one of the co-authors says, "Entangled states are typical and general. The only problem is that for the majority of particles, interaction with the environment destroys the entanglement. And photons hardly ever interact with other particles. Thus, they are a very convenient object for experiments in this sphere. Most light sources we encounter in daily life are classical ones—for instance, the sun, stars, incandescent lamps, and so on. Coherent laser radiation is also classical. To create nonclassical light isn't an easy thing. You could, for instance, isolate a single atom or an artificial structure like a quantum dot and detect its radiation—this is the way to obtain single photons."

Spontaneous parametric down-conversion in nonlinear crystals is most commonly used for obtaining entangled photon states. In this process, a laser beam splits into two. As this takes place, photon states become correlated, entangled due to conservation laws. Egor Kovlakov, a doctoral student from the Lomonosov Moscow State University and a co-author says, "In our project, we've offered and tested a new technique for creating spatial entanglement. Photon pairs generated in our experiment propagate by beams, which become correlated in spatial profile."

Studies of entangled photon states began in the 1970s, and today, they are most actively used in quantum cryptography, an area relating to quantum information transfer and quantum communication.

Stanislav Straupe says, "Quantum cryptography is not the only possible application, but at the moment, it is the most advanced one. Unlike classical communication, in which it's enough to use a binary alphabet (0 or 1), everything is more complicated in quantum communication. It turns out that enhancement of the alphabet dimension not only increases the amount of information coded in one photon, but also strengthens communication security. That's why it would be interesting to develop quantum communication systems based also on information coding in the spatial profile of photons." The scientists believe that in the future, their solution could be applied to create an optical channel with a satellite, where you can't install an optical fiber guide—fundamental for fiber-optic communication.

More information: E. V. Kovlakov et al, Spatial Bell-State Generation without Transverse Mode Subspace Postselection, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.118.030503

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