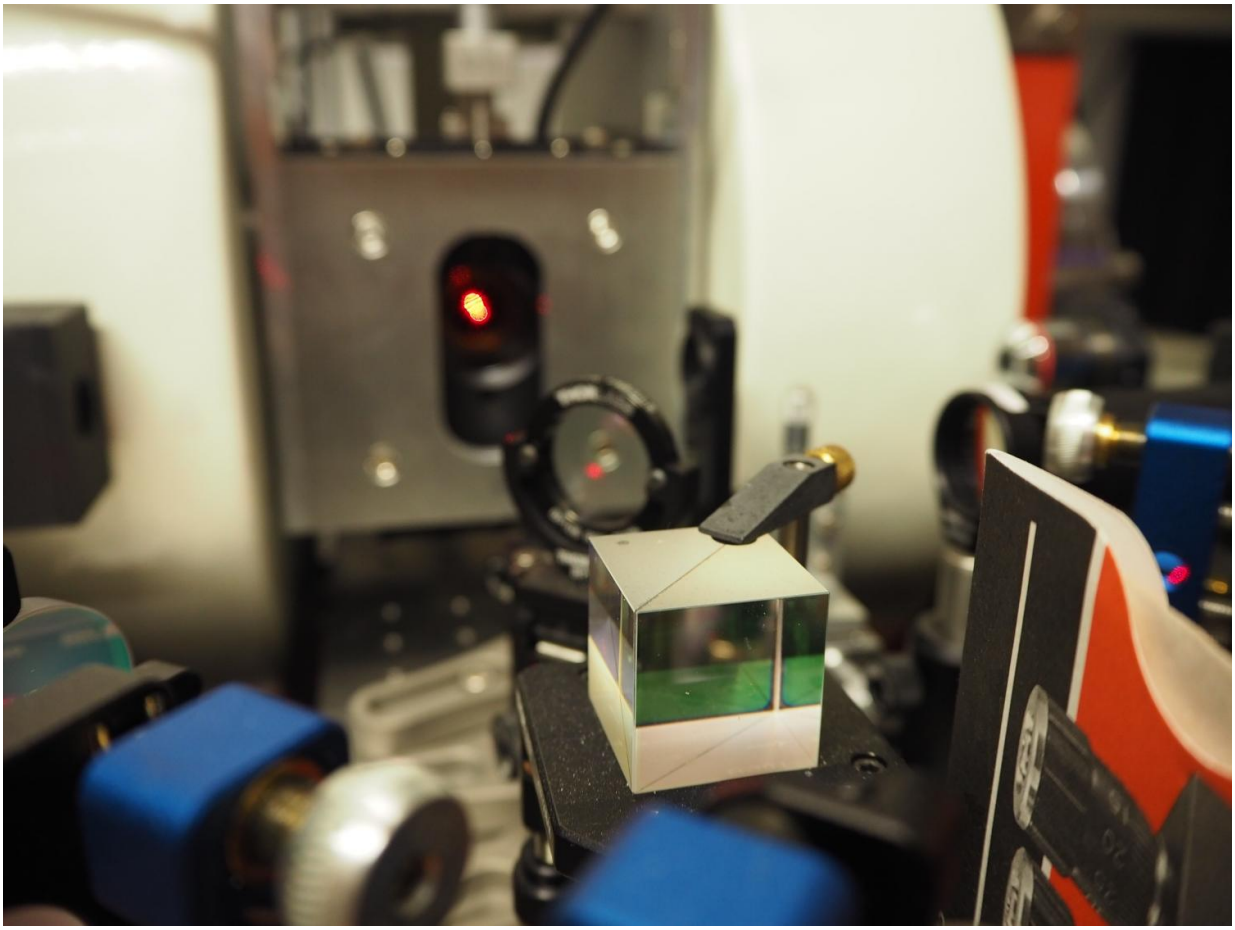
Researchers use quantum dots to manipulate light

August 30 2016, by Erik Arends



Credit: Leiden Institute of Physics

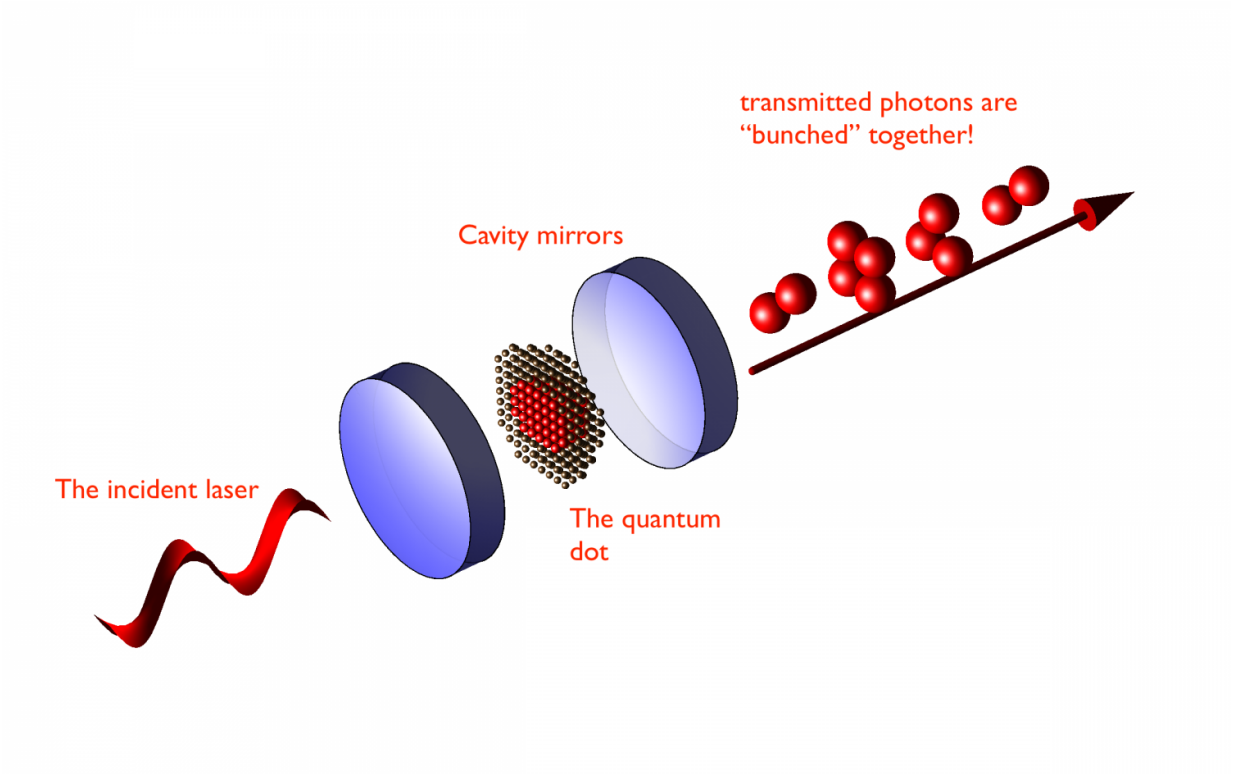
Leiden physicists have manipulated light with large artificial atoms, so-

called quantum dots. Before, this has only been accomplished with actual atoms. It is an important step toward light-based quantum technology. The study was published on August 30th in *Nature Communications*.

When you point a laser pointer at the screen during a presentation, an immense number of light particles races through the air at a billion kilometers per hour. They don't travel in a continuous flow, but in packages containing varying numbers of particles. Sometimes as many as four so-called photons pass by, and other times none at all. You won't notice this during your presentation, but for light-based quantum technology, it is crucial that scientists have control over the number of photons per package.

Quantum dots

In theory, you can manipulate photons with real individual atoms, but because of their small size, it is extremely hard to work with them. Now, Leiden physicists have discovered that the same principle goes for large artificial atoms—so-called quantum dots—that are much easier to handle. In fact, they managed to filter light beams with one photon per package out of a laser. "Another big advantage of quantum dots is that the system already works within nanoseconds," says first author Henk Snijders. "With atomic systems, you need microseconds, so a thousand times longer. This way, we can manipulate photons much faster."



Between two mirrors, the quantum dot filters the light beams with just one photon per package out of the laser, so that only packages with multiple photons remain. Credit: Leiden Institute of Physics

Quantum cryptography

The ultimate goal for the research group led by Prof. Dirk Bouwmeester is to entangle many photons using quantum dots. This is essential, for example, in techniques like quantum cryptography. Snijders: "This research shows that we are already able to manipulate individual photons with our system. And the beauty is that in principle, we don't need large experimental setups. We can just integrate our quantum dots in small microchips."

More information: H. Snijders, J. A. Frey, J. Norman, M. P. Bakker, A. Gossard, J. E. Bowers, M. P. van Exter, D. Bouwmeester and W. Löffler, 'Purification of a single photon nonlinearity', *Nature Communications* (2016)

Provided by Leiden Institute of Physics