Physics breakthrough much ado about 'nothing'

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How do scientists store nothing? It may sound like the beginning of a bad joke, but the answer is causing a stir in the realm of quantum physics after two research teams, including one from the University of Calgary, have independently proven it's possible to store a special kind of vacuum in a puff of gas and then retrieve it a split second later.

In our everyday life, light is completely gone when we turn it off. In the world of quantum physics, which governs microscopic particles, even the light that is turned off exhibits some noise. This noise brings about uncertainty that can cause trouble when trying to make extremely precise measurements.

Using crystals to manipulate laser light, researchers create a peculiar type of nothingness known as a "squeezed vacuum," which under certain conditions, exhibits less noise than no light at all. A squeezed vacuum is employed in gravitation wave detection; it is also important in the booming field of quantum information technology, where it is used to carry information and to generate an even more mysterious quantum object, entangled light.

Building on the 2001 breakthrough of Harvard-Smithsonian scientists who slowed light down to a stop, teams of physicists from the U of C and the Tokyo Institute of Technology have independently demonstrated that a squeezed vacuum can be stored for some time in a collection of rubidium atoms and retrieved when needed. In work to be published in the March 7 advanced online edition of the leading physics journal

Physical Review Letters, the physicists measured the noise of the retrieved light and found it to remain “squeezed” compared to no light at all.

“Memory for light has been a big challenge in physics for many years and I am very pleased we have been able to bring it one step further,” said Alexander Lvovsky, professor in the Department of Physics and Astronomy, Canada Research Chair and leader of the U of C’s Quantum Information Technology research group. “It is important not only for quantum computers, but may also provide new ways to make unbreakable codes for transmitting sensitive information”.

"I'm very impressed," physicist Alexander Kuzmich of the Georgia Institute of Technology in Atlanta told the American Association for the Advancement of Science’s ScienceNOW news service of the squeezed vacuum discovery. Kuzmich, who was able to store and retrieve a single photon in 2006, said the development could help create new types of quantum networks for ultra-secure information transmission and help spell out the boundary of the quantum realm. "It's a real technical achievement," he said.

Lvovsky’s team is continuing work on light storage and is now investigating the possibility of storing more complex forms of quantum light, such as entangled light, which has a wide range of applications for quantum computing and information exchange.

A pre-press copy of Lvovsky et al’s paper “Quantum memory for squeezed light” from the journal Physical Review Letters can be obtained online at: arxiv.org/abs/0709.2258

Source: University of Calgary