

# COSMOS magazine



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## News

### A trick of the light

Agence France-Presse

PARIS: In a startling sub-atomic light show, U.S. scientists have made a tiny pulse of light stop, jump from one group of atoms to another and then continue on its way.

While the experiments, conducted at Harvard University in Boston are consistent with quantum mechanics - the strange laws governing the behaviour of sub-atomic particles - the results are still startling, said scientists, because they were so hard to demonstrate and because of their potential applications in technology.

"When I saw the study I did not at first believe it," said Michael Fleischhauer of the Technical University in Kaiserslautern, Germany. "It shows that we are entering a state of unprecedented experimental control of coherent light and matter waves."

To get the light beams to dance from one group of atoms to another, a team of Harvard physicists led by Naomi Ginsberg fired a laser into a cloud of atoms that had been chilled to a fraction of a degree above absolute zero in a slow-moving state known as Bose-Einstein condensate.

The pulse of light, composed of particles called photons, was "slowed down from 300,000 kilometres per second to 20 km per hour" and then to a standstill, its information stored inside the frigid, treacherous cloud, explained co-author Lene Vestergaard Hau.

What has happened up to this point is a phenomenon well known to scientists (See [A picture is worth a single photon](#), Cosmos Online). But when the laser was turned off, the light pulse made an imprint - "like a hologram," said Hau - that started moving slowly until it exited the condensate cloud into free space. "What you wind up with is an absolute perfect copy of the light pulse, but in matter form," she said.

And then, in a true 'quantum leap', the transformed

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In a stunning confirmation of the laws of quantum mechanics, physicists at Harvard University have managed to slow down a beam of light, cause it to jump from one group of atoms to another, and then continue on its way.

*Credit: iStockphoto*



photons jumped to a neighbouring condensate cloud a fraction of a millimetre away, where the original light field reappeared.

"It is one of those things that are known from theory but are still counter-intuitive," said Fleischhauer, in a commentary that appeared alongside the study in today's edition of the British journal *Nature*. According to the team, the photons were transferred from one cloud to the next because the optical pulse was converted into a wave of travelling matter.

These experiments hold the promise of "very real technological benefits," said Fleischhauer. The information technology revolution has long been driven by advances in the miniaturisation of electronic circuitry on silicon chips, with performance doubling roughly every 18 to 24 months - a phenomenon called Moore's Law, after former Intel chief Gordon Moore who proposed it in 1965.

But the shrinkage is fast approaching an atomic scale, which will require entirely new designs. "One of the goals of quantum information processing with photons is to build a network, and for a network you need nodes and carriers," observed Fleischhauer. "Photons serve as the carriers for quantum information, and the atoms are ideal for storage and processing."

Hau explained that when the photons are transformed into a matter form they are easier to manipulate. "You can grab onto it and put it on the shelf and keep it awhile," she said.

Ginsberg and her co-authors also pointed to future applications in measurement instruments that would be several orders of magnitude more sensitive than anything existing today.

According to the team, harnessing the "matter waves" contained in atoms would make it possible to design ultra-accurate atomic clocks, gravity detectors and interferometers used to measure rotation and acceleration.

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