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# Light show makes a quantum leap

**Light beams that dance from one cloud to another in an amazing show have left quantum physicists shaking their head in wonder**

IN a sub-atomic light show that has had quantum physicists shaking their head in wonder, American scientists have made a tiny pulse of light stop, jump from one group of atoms to another and then continue on its merry way.

The experiments, conducted at Harvard University, are consistent with quantum mechanics, the laws governing the behaviour of atoms that Albert Einstein postulated in the 1920s at a time when it was technically impossible to prove him right or wrong.

But the results are still startling, say 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, a professor at 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 cloud to another, Naomi Ginsberg and a team of physicists at Harvard fired a laser into a cloud of atoms that had been deep chilled into a slow-moving state known as Bose-Einstein condensate.

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

What has happened up to this point is a phenomenon well known to scientists.

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 photons entered into the 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, who wrote a commentary, which, like the study, was published in the British journal *Nature* on Thursday.

The data are transferred from one cloud to the next because the optical pulse is converted into a wave of travelling matter, the authors say.

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 – often called "Moore's Law."

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 points out 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 his co-authors also point to future applications in measurement instruments that would be several orders of magnitude more sensitive than anything existing today.

Harnessing the "matter waves" contained in atoms would make it possible to design ultra-accurate atomic clocks, gravity detectors and interferometers used to measure rotations and accelerations. – AFP

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