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Research to improve fiber optics and computing

Dr. Lene Hau, Mallinckrodt professor of physics and applied physics at Harvard University, has discovered applications through her work with light and matter that will impact the Air Force by providing significant advances in computing, optical networks and quantum cryptography. (Photo courtesy of Justin Ide/Harvard News Office)

by Maria Callier
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2/19/2009 - **ARLINGTON, Va. (AFNS)** -- An internationally celebrated physicist and researcher, funded by the Air Force Office of Scientific Research, the National Science Foundation and NASA, has overseen work leading to the first successful manipulation of coherent optical information.

Dr. Lene Hau has discovered applications through her work with light and matter that will impact the Air Force by providing significant advances in computing, optical networks and quantum computing.

In her earlier work, Dr. Hau slowed light down to 38 mph by shooting a laser through very cold atoms. Then she halted light, restarted it and sent it on its way.

More recently, Dr. Hau and her co-researchers, Dr. Naomi S. Ginsberg and Dr. Sean R. Garner, stopped and extinguished a light pulse in a tiny, supercooled sodium cloud called a Bose Einstein Condensate, and then brought the light pulse back into existence in another atom cloud in a separate location.

The information inside the light pulse was transferred from the first to the second cloud by converting the light pulse into a travelling matter wave, a small atom pulse that was a perfect matter copy of the extinguished light pulse. After the matter wave entered the second cloud, the atoms there worked together to restore the original light pulse.

Currently, scientists and engineers working in optical networks and quantum cryptography are only able to store an optical signal, but Dr. Hau's work will enable them to have a greater degree of control over information processing than ever before.

"This work could provide a missing link in the control of optical information," Dr. Hau said in a Harvard University press release. "While the matter copy is traveling between the two Bose-Einstein Condensates, we can trap it, potentially for minutes, and reshape it in whatever way we want. The induced changes will then be present in the revived light pulse."

Dr. Hau and graduate student Brian Murphy's work showing the first merging of cold atom and nanoscale technologies appeared as a cover story of an issue of Physical Review Letters and in the journal, Physics.

Dr. Hau noted that the work is important to computer chips and will result in new devices and physics research at a very small scale.

Her research has caught the attention of the national and international media as well as Harvard University. Recently, she was awarded the university's George Ledlie Prize for research in the area of light and matter. The Ledlie Prize is awarded no more than once every two years to a researcher who "since the last awarding of said prize has by research, discovery or otherwise made the most valuable contribution to science, or in any way for the benefit of mankind."

"I am very honored to receive the prize," Dr. Hau said in an interview with Harvard University's Gazette Online. "It is really wonderful to receive this kind of recognition from your home institution."

In the same article, Harvard's Provost Steven E. Hyman lauded Dr. Hau's work by noting that "her research blurs the boundaries between basic and applied science, draws on the talent and people of two schools and

several departments and provides a literally glowing example of how taking daring intellectual risks leads to profound rewards."

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