

PRESS RELEASE

Light that travels... faster than light!

A team of researchers from the Ecole Polytechnique Fédérale de Lausanne (EPFL) has successfully demonstrated, for the first time, that it is possible to control the speed of light – both slowing it down and speeding it up – in an optical fiber, using off-the-shelf instrumentation in normal environmental conditions. Their results, to be published in the August 22 issue of Applied Physics Letters, could have implications that range from optical computing to the fiber-optic telecommunications industry.

On the screen, a small pulse shifts back and forth – just a little bit. But this seemingly unremarkable phenomenon could have profound technological consequences. It represents the success of Luc Thévenaz and his fellow researchers in the Nanophotonics and Metrology laboratory at EPFL in controlling the speed of light in a simple optical fiber. They were able not only to slow light down by a factor of three from its well – established speed c of 300 million meters per second in a vacuum, but they've also accomplished the considerable feat of speeding it up – making light go faster than the speed of light.

This is not the first time that scientists have tweaked the speed of a light signal. Even light passing through a window or water is slowed down a fraction as it travels through the medium. In fact, in the right conditions, scientists have been able to slow light down to the speed of a bicycle, or even stop it altogether. In 2003, a group from the University of Rochester made an important advance by slowing down a light signal in a room-temperature solid. But all these methods depend on special media such as cold gases or crystalline solids, and they only work at certain well-defined wavelengths. With the publication of their new method, the EPFL team, made up of Luc Thévenaz, Miguel González Herraes and Kwang-Yong Song, has raised the bar higher still. Their all-optical technique to slow light works in off-the-shelf optical fibers, without requiring costly experimental set-ups or special media. They can easily tune the speed of the light signal, thus achieving a wide range of delays.

“This has the enormous advantage of being a simple, inexpensive procedure that works at any wavelength, notably at wavelengths used in telecommunications,” explains Thévenaz.

The telecommunications industry transmits vast quantities of data via fiber optics. Light signals race down the information superhighway at about 186,000 miles per second. But information cannot be processed at this speed, because with current technology light signals cannot be stored, routed or processed without first being transformed into electrical signals, which work much more slowly. If the light signal could be controlled by light, it would be possible to route and process optical data without the costly electrical conversion, opening up the possibility of processing information at the speed of light.

This is exactly what the EPFL team has demonstrated. Using their Stimulated Brillouin Scattering (SBS) method, the group was able to slow a light signal down by a factor of 3.6, creating a sort of temporary “optical memory.” They were also able to create extreme conditions in which the light signal travelled faster than 300 million meters a second. And even though this seems to violate all sorts of cherished physical assumptions, Einstein needn’t move over – relativity isn’t called into question, because only a portion of the signal is affected.

Slowing down light is considered to be a critical step in our ability to process information optically. The US Defense Advanced Research Projects Agency (DARPA) considers it so important that it has been funnelling millions of dollars into projects such as “Applications of Slow Light in Optical Fibers” and research on all-optical routers. To succeed commercially, a device that slows down light must be able to work across a range of wavelengths, be capable of working at high bit-rates and be reasonably compact and inexpensive.

The EPFL team has brought applications of slow light an important step closer to this reality. And Thévenaz points out that this technology could take us far beyond just improving on current telecom applications. He suggests that their method could be used to generate high-performance microwave signals that could be used in next-generation wireless communication networks, or used to improve transmissions between satellites. We may just be seeing the tip of the optical iceberg.

For further information

Luc Thévenaz, tel. +41 21 693 4774, e-mail: luc.thevenaz@epfl.ch

Mary Parlange, EPFL Press Office, tel. +41 21 693 7022, e-mail: mary.parlange@epfl.ch