for the light and the applied microwave fields. So rather than interacting on a centimetre-length scale, as in the conventional electro–optic modulators, the applied microwave field interacts with a few tens of metres of light in the $LiNbO_3$. The result is an extremely-high-efficiency modulator that eliminates the need for an amplifier to obtain signals with high enough power. The UCLA's WGM resonator is a disc of $LiNbO_3$ with a radius of 2.85 mm and achieves $Q \approx 1.1 \times 10^6$.

In previous demonstrations of WGM-based modulators, the interaction of the light and the microwave fields was implemented with metallic strip-line waveguides and electrodes. This, of course, is also undesirable for the receiver. The UCLA scheme uses electrodeless coupling of the microwave radiation to the WGM resonator by designing the dielectric antenna to deliver a concentration of the microwave field in the proximity of the disk. This was the last step needed to allow a receiver immune to a large electromagnetic blast to be devised. They designed the dielectric antenna to concentrate the power and applied it close to the resonator.

This work is noteworthy because it so clearly demonstrates the power of microwave photonics in addressing problems that are beyond the reach of direct electronic solutions. It also demonstrates the power of the photonics technology to address one of the most important societal problems of our time, that of national security.

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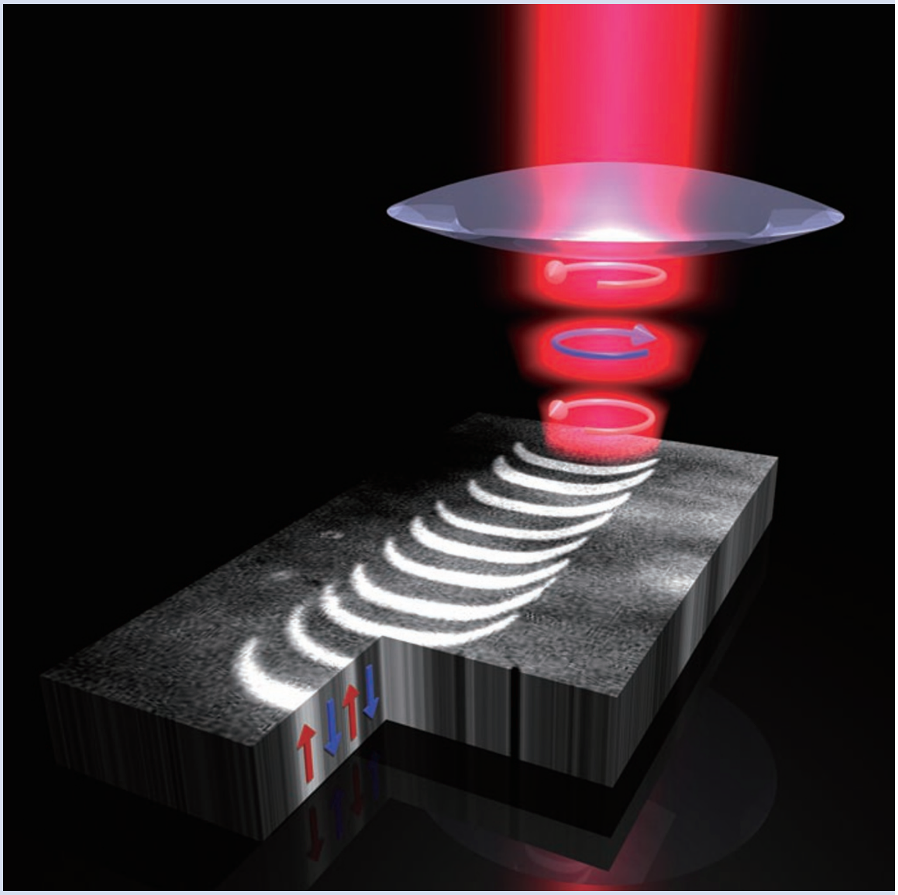
DATA STORAGE

As quick as light

Magnetic media are rapidly replacing paper as the material of choice for storing information; faster writing speeds and a longer lifetime are just a couple of the benefits on offer. The technology is continually developing to store information in a smaller space and in a quicker time, driven by the ever increasing demand for storage capacity. Scientists from the Radboud University Nijmegen in the Netherlands and Nihon University in Japan have now shown experimentally how light can be used to dramatically increase writing speeds (*Phys. Rev. Lett.* **99,** 047601; 2007).

Magnetic memory devices, such as the hard disks in many computers, store digital information by locally altering the magnetic properties, as measured by the so-called magnetization vector. For example, '0's can be represented by magnetization pointing downwards whereas '1's can be stored as upwards magnetization. The conventional way of changing from one state to the other is by applying a magnetic field. However, recent research has indicated that this process may take at least 2 ps, ultimately limiting the maximum possible writing speed.

Laser light has already been shown to offer a small degree of control of magnetization, but for data-storage applications, a full 180° rotation is required. This is the challenge that Daniel Stanciu and co-workers have set about tackling. The team sandwiched a 20-nm layer of the commonly used magnetic alloy GdFeCo in between two layers of silicon nitride. Placed under a polarizing microscope, the sample was illuminated with a 100-μm spot of pulsed, circularly polarized laser light. By changing the direction of the polarization, right-handed or left-handed, the magnetization of the materials under the laser spot can be controlled up or down respectively. The laser was swept very quickly across the sample, demonstrating that only one pulse was necessary for this flipping to occur. And these laser pulses were just 40-fs long, proving that optics provides a much faster technique for magnetization reversal than magnetic fields. What is most extraordinary about these results is that magnetization writing at these speeds was thought impossible. And, with the integration of lasers into magnetic storage devices already possible, these results provide an exciting route to high-speed magnetic data storage.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