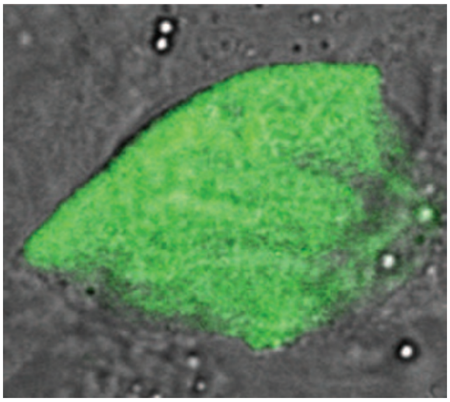
BIOPHOTONICS
## Single-cell transfection
*Biomed. Opt. Express* **4,** 1533–1547 (2013)





Transfection, the injection of genes into living cells, is an essential component of gene therapy. However, existing transfection techniques that operate at the single-cell level either are clumsy or can damage the cells. Now, Muhammad Waleed and co-workers from Gwangju Institute of Science and Technology in South Korea have demonstrated a way to insert precisely a gene into an individual cell without damaging neighbouring cells during the process. They used a tightly focused near-infrared femtosecond laser pulse to puncture the cellular membrane of a MCF-7 cancer cell at a single point. They then used optical tweezers to insert a plasmid-coated polystyrene microparticle into the cell. Laser irradiation with a power of 75 mW for 100 ms was sufficient to form a 3-μm-diameter hole in the cell membrane and to insert a 1-μm-diameter microparticle. The team observed that, after irradiation had finished, the cell membrane healed completely within 3.5 s and that it grew like an unirradiated cell. The transfected cell exhibited green fluorescent protein expression, demonstrating successful transfection. Because of its high selectivity and control over a single cell, this approach will aid the monitoring and study of genetic changes in specific cells. *RW*

OPTOACOUSTICS
## Cleaving cells
*Biomed. Opt. Express* **4,** 1442–1450 (2013)

Hyoung Won Baac and co-workers from the University of Michigan and the Wellman Center for Photomedicine in the USA report that laser-generated focused ultrasound can be used to perform high-precision, non-contact cleaving of cell clusters. They generated focused ultrasound by firing 6-ns laser pulses (wavelength, 532 nm) onto an optoacoustic lens consisting of a carbon-nanotube—polymer composite film on a concave fused-silica substrate. A 12-mm-diameter lens confined the laser-generated ultrasound to a focal region measuring 100 μm laterally and 650 μm axially, whereas a 6-mm-diameter lens provided tighter confinement of 75 μm and 400 μm, respectively. Experiments with cultured ovarian cancer cells showed that high-quality, precise ultrasonic cleaving of cell clusters was possible when the laser pulse energy exceeded 50 mJ. The findings suggest that laser-generated focused ultrasound is promising as a non-contact, non-thermal approach for performing cell and tissue surgical processes such as cleaving, patterning and harvesting. *OG*

LENS-FREE IMAGING
## Opto-magnetics
*Lab Chip* http://dx.doi.org/10.1039/C3LC50707F (2013)

Frederik Colle and colleagues in Belgium have demonstrated a rapid and sensitive lens-free imaging technique for lab-on-chip analysis of nucleic acids. The optomagnetic approach allows detection of DNA fragments that have been labelled with magnetic particles. First, external magnets are used to attract magnetic particles towards a functionalized surface, where they bind to and label DNA. Next, other sets of magnets above the surface are used to remove unbound particles from the field of view during lens-free imaging, which is performed using partially coherent illumination from a light-emitting diode. The interference patterns obtained are reconstructed using software. This method reportedly allows DNA fragment detection at a concentration range down to 10 pM. It offers high sensitivity, and requires minimal hardware and a low computing power, thus making it promising for realizing a compact, inexpensive device for point-of-care DNA quantification. *RW*

QUANTUM OPTICS
## High-fidelity teleportation
*Phys. Rev. Lett.* **111,** 050504 (2013)

The continuous-variable teleportation protocol is a fundamental and important element in many continuous-variable quantum information protocols, such as those used in quantum repeaters and measurement-induced quantum computation. This protocol has the advantages of permitting deterministic implementation and having a high efficiency. However, the teleportation fidelity is technically limited, as a fidelity of 100% would require infinitely squeezed light sources. Now, Ulrik Andersen from the Technical University of Denmark and Timothy Ralph from the University of Queensland in Australia have proposed a new scheme that can yield a teleportation fidelity close to 100% for continuous-variable states. The researchers proposed using an ensemble of maximally entangled single-photon states rather than squeezed states. In their scheme, the input state was divided into $N$ modes, each of which was teleported with a qubit teleporter. The teleported outputs were recombined in an $N$ splitter, and success was obtained if all photons exited from one port. A numerical calculation showed that the proposed teleporter outperformed the standard entanglement swapping protocol. A teleportation fidelity as high as 99.2% was achieved by using 100 single-photon states, even when the quantum transmission channel was lossy. *NH*

SENSORS
## Spinning object detection
*Science* **341,** 537–540 (2013)

The linear Doppler effect — whereby a wave emitted or scattered by a moving object is shifted in frequency — has become a useful tool for measuring the velocity of an approaching or receding object, such as a speeding car or a galaxy. Now, scientists in Scotland have shown that, in a similar fashion, frequency shifts in helically phased light beams can be used to detect spinning objects and obtain information about them. Martin Lavery and co-workers from the Universities of Glasgow and Strathclyde in the UK theoretically showed that the rotational speed of a distant spinning object can be determined by analysing the orbital angular momentum and the frequency shift of light scattered by it. They experimentally confirmed this by illuminating a metal reflector spinning at rates between 200 rad $s^{-1}$ and 500 rad $s^{-1}$ with red light that had specially prepared orbital angular momentum states. Their finding is anticipated to be useful for remote sensing applications such as turbulence analysis and the detection of rotating objects in astronomy. *OG*