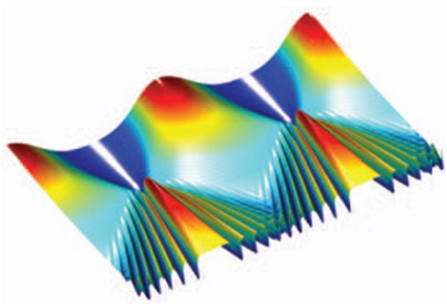
NONLINEAR OPTICS
Second-harmonic edges
Science **344,** 488–490 (2014)

Molybdenum disulphide (MoS_2) is a popular two-dimensional material, and single layers of MoS_2 have previously been shown to support strong second-harmonic generation. Now, Xiaobo Yin and colleagues from the University of California, Berkeley, and Columbia University, New York, claim to have observed one-dimensional nonlinear optical edge states in atomically thin MoS_2 sheets. The team fabricated triangles of the monolayer by chemical vapour deposition. When samples were pumped with an excitation wavelength of 1,280 nm, self-assembly occurred uniformly across the samples. In contrast, when the pump wavelength was shifted to 1,300 nm, self-assembly at the edges of the sample was enhanced relative to that elsewhere. The researchers claim that the different electronic structures at the edges of the two-dimensional crystal cause different nonlinear optical susceptibilities. They demonstrate the usefulness of this finding by showing that imaging the sample edges can be used to rapidly determine crystal orientations. *DP*

OPTOFLUIDICS
Laser-assisted assay
Nature Commun. **5,** 3779 (2014)

Enzyme-linked immunosorbent assay (ELISA) is a well-known technique for biomolecular analysis. Xiang Wu and a team from the University of Michigan (USA), Fudan University (China) and the University of Texas (USA) have now demonstrated that using an optofluidic laser can aid ELISA tests. This technique is particularly interesting because the ELISA occurs inside the laser cavity. The laser is pumped by a pulsed optical parametric oscillator (wavelength, 535 nm; pulse width, 5 ns; repetition rate, 20 Hz; threshold; ~320 μJ mm^{-2}). The laser turn-on time is used as the sensing signal; it is inversely proportional to the enzyme concentration and hence also to the analyte concentration in the cavity. The optofluidic laser-based ELISA test has the advantage that it can better isolate the ELISA signal from background signals, such as excitation light leakage. The team demonstrated the utility of the concept by the dual-mode detection of interleukin-6 using commercial ELISA kits. In this comparison, sensing signals were simultaneously detected by the optofluidic laser-based ELISA and by conventional ELISA. The new technique had a detection limit of 1 fg ml^{-1} (38 aM) and a dynamic range of six orders of magnitude, whereas the conventional ELISA results became unreliable below a concentration of ~10 fg ml^{-1}. *DP*

NONLINEAR OPTICS
Shock waves
Phys. Rev. X **4,** 021022 (2014)



Four-wave mixing (FWM), a nonlinear optical effect, is an important phenomenon for applications requiring parametric amplification and frequency conversion. Now, scientists in Europe have shown that wave-breaking effects can dramatically affect nonlinear frequency-conversion processes. Specifically, they report that dispersive shock waves, which mimic undular bores in hydrodynamics, can spontaneously form during FWM. Julien Fatome and co-workers from France, Germany and Italy studied the formation and collision of such optical undular bores in standard telecom fibres using nearly periodic optical pulses. The scientists used a 6-km-long nonzero dispersion-shifted fibre with a low normal dispersion of –2.5 ps nm^{-1} km^{-1}. Optical pulses from an external cavity laser with a wavelength of 1,555 nm were modulated by a $LiNbO_3$ intensity modulator at 28 GHz and then coupled to the optical fibre. The power of the input pulses was about 5 W. The temporal waveform of the pulses was observed at the output using an optical sampling oscilloscope. The scientists found that the initial modulation underwent a hydrodynamic type of instability that greatly affected the FWM process. They observed the generation and interaction of undular bores under different FWM configurations. These results provide a better understanding of several applications based on FWM in the high-efficiency regime. *NH*

TRANSFORMATION OPTICS
Nonlinear focusing
J. Opt. **16,** 055202 (2014)

Broadband omnidirectional electromagnetic absorbers — so-called optical black holes — have become a popular topic in recent years, especially those based on cylindrical nonlinear materials. To date, analysis has largely relied on linear transformational optics, but this is insufficient for describing extremely strong nonlinear effects in a small area. Now, Yuriy Rapoport and co-workers from Ukraine, the UK and Mexico have developed a method based on nonlinear transformation optics to investigate nonlinear optical phenomena at very high intensities. The team considered an infinitely long dielectric cylinder composed of an inner core and an outer shell. The nonlinear optical coefficient of the inner core was constant, whereas that of the outer shell varied with the radius. The scientists investigated how incident beams are focused inside the rod by accounting for the nonlinearity saturation, the nonlinear loss and the linear gain. The numerical simulation indicates that when the intensity of any beam exceeds a certain threshold, nonlinear focusing may occur. When this happens, the peak position of the intensity distribution jumps from some point inside the inner core to a point near the interface between the inner core and the outer shell. *NH*

PHOTOCHROMIC MATERIALS
Switchable absorber
Adv. Opt. Mat. http://dx.doi.org/10.1002/adom.201400105 (2014)

By coating a highly reflective gold-film mirror with a thin layer of polystyrene doped with a photochromic spirooxazine polymer, researchers have created a photoswitchable super absorber. Mady Elbahri and co-workers say that the reflectivity of the metal mirror, which is usually very high, can be reduced to just a few percent by illuminating it with ultraviolet light. The structure's reflectivity can then be switched back to a high value by applying visible light. This dramatic change in the optical characteristics is due to the photochromism of the spirooxazine molecule, whose C–O bonds break when it is illuminated with ultraviolet light, causing it to become highly absorbing in the 500–700 nm wavelength window. By placing the structure in a cavity, it was possible to optically switch between weak and strong plasmon coupling. This approach may prove useful for sensing applications and for creating optically controlled plasmonic switches. *OG*

Written by Oliver Graydon, Noriaki Horiuchi, David Pile and Simon Pleasants.