Technology in Clear Water Bay show how such a device might work to hide an object outside its confines.

In their theoretical scheme, the custom-made shield creates an 'anti-object' image that cancels out the light-scattering of the hidden object nearby, so that in optical terms the whole system is replaced by empty space.

The researchers provide a prescription for making anti-objects of arbitrary shape embedded in slabs of metamaterials, which are composed of building blocks that interact with light in unusual, tailor-made ways.

PALAEONTOLOGY

Bird in the hand

PLoS ONE **4**, e4591 (2009)

Prints left by a squatting bipedal dinosaur show clearly that the hands faced inwards, as birds' limbs do now to allow for wing folding. The prints, which are almost 200 million years old, are preserved in Utah sandstone.

The dinosaur was a theropod — one of a group of mainly carnivorous dinosaurs, such as tyrannosaurs and velociraptors, that were the ancestors of modern birds. The prints suggest that theropods exhibited bird-like anatomy and resting postures much earlier than previously recognized.

Andrew Milner, curator at Utah's St George Dinosaur Discovery Site, and his colleagues theorize that the unknown creature's hand orientation was for grabbing or holding prey.

NEUROBIOLOGY

Second fiddle

Science **323,** 1313–1319 (2009)

Ion channels known as AMPA receptors help to transmit fast excitatory nerve impulses in the brain. Changes to their properties, which are regulated by other proteins, are crucial to many processes, including some involved in learning and memory.

TARP proteins were thought to be the only candidates for AMPA-receptor regulation. Yet in the rat brain such proteins associate with only about 30% of AMPA receptors.

Bernd Fakler and Nikolaj Klöcker at the University of Freiburg in Germany and their colleagues have unexpectedly come across what turns out to be the predominant partner proteins, using a quantitative proteomics approach. They found that, in rat brains, about 70% of AMPA receptors associate with cornichon proteins. Cornichons and TARPs regulate the function and expression of AMPA receptors differently, potentially allowing fine-tuning of fast nerve-impulse transmission.

ECOLOGY

Open goal

Proc. R. Soc. B doi:10.1098/rspb.2008.1762 (2009)

A host of grasses, including crops such as maize (corn) and sugarcane, grow well in hot, dry conditions because they have evolved a more efficient type of photosynthesis, the C_4 pathway, which requires less water than the more widespread C_3 pathway.

Some scientists believe that C_4 photosynthesis evolved to cope with drought, but others argue it was originally an adaptation to exposed habitats.

Colin Osborne and Robert Freckleton at the University of Sheffield, UK, have now settled the debate by analysing the habitats of 117 genera of grasses, representing 15 independent C_4 lineages. They provide strong evidence that C_4 plants first arose in open, tree-less environments. Once the pathway had evolved, however, C_4 plants would have been able to adapt faster to dry environments than C_3 plants.

N. CATTLIN/FLPA

MATERIALS SCIENCE

Diaphite domains

Phys. Rev. Lett. **102,** 087402 (2009); *Phys. Rev. B* **79,** 054111 (2009)

Graphite, a form of carbon made up of layered sheets of atoms, transforms into diamond — another form — only when subjected to high pressure. But Katsumi Tanimura at Osaka University in Japan, Hiromasa Ohnishi at the Institute of Materials Structure Science in Tsukuba and their colleagues have found that by firing femtosecond (10^{-15} s) laser pulses at a graphite wafer, they can cause five-nanometre-diameter patches of the flat layers to buckle and become three-dimensional.

The patches, which form a structure that exhibits bonding between layers but differs from a diamond lattice, have been termed 'diaphite' domains. The material is stable at room temperature if kept under ultra-high vacuum.

JOURNAL CLUB

Frank Wilczek
Massachusetts Institute of Technology, Cambridge

A theoretical physicist examines exotic particles lurking in new materials.

Axions are very light, very weakly interacting particles, whose existence was posited more than 30 years ago in order to clean up our 'standard model' of particle physics. They close an annoying loophole in Kobayashi and Maskawa's Nobel prizewinning explanation of why the microscopic laws of physics look so nearly the same when running backwards as forwards in time (time reversal symmetry).

Despite heroic efforts — and several false alarms — axions have not yet been detected, but they have become increasingly important. They have been warmly embraced in unified field theories and in string theory. And when we run the equations through Big-Bang cosmology, we find that axions should contribute much of the dark matter that astronomers have inferred to explain the Universe.

Now Shou-Cheng Zhang and his colleagues (X.-L. Qi *et al. Phys. Rev. B* **78,** 195424; 2008) inform us that, all along, axions have been lurking unrecognized on surfaces of bismuth–tin alloys and other materials. To be more precise: the equations that arise in axion physics are the same as those that describe the electromagnetic behaviour of a recently discovered class of materials known, collectively, as topological insulators.

The axion field inside topological insulators is an emergent — and subtle — property of collections of electrons that is connected to their spin–orbit coupling.

These 'quasi-axions' don't improve our standard model, but they do have the charming advantage of being accessible, possibly even useful. There are ideas to exploit their behaviour to make anyons, potential building blocks for quantum computation.

No short summary can do justice to the wealth of ideas synthesized in this paper. Powerful, beautiful mathematics is at play in reality.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**