Mass dependence

Phys. Rev. Lett. **108,** 191302 (2012)

By the end of the year, as the excellent performance of the Large Hadron Collider continues, CERN should have a definitive statement on the existence (or not) of a Higgs boson with a mass of about 125 GeV. Isabella Masina and Alessio Notari will no doubt be watching with interest, as they propose an inflation scenario that hinges on the Higgs having a mass in exactly that region.

Masina and Notari have previously explored a model in which, for a narrow range of values of the Higgs mass and of the mass of the top quark, the standard-model potential has a local minimum at an energy scale of 10^{16} GeV. That local minimum is interesting, because it could feasibly be the starting point for inflation — a period of exponential expansion in the early Universe.

From fits of global data, the precision on the top quark mass has now improved to below the 1-GeV mark, and Masina and Notari's calculations put the Higgs mass at 126±3.5 GeV. One other parameter has now come into play, arising from the inflationary gravitational-wave background, and that's the ratio of tensor to scalar modes — something that the authors say could soon be measureable using apparatus such as ESA's Planck satellite, as a test of their inflation hypothesis. *AW*

Catch the wave

Nature Photon. http://doi.org/hww (2012)

Many precision experiments in physics and chemistry rely on the control of the particle velocities in atomic and molecular beams. Charged particles, atoms and molecules can be accelerated or decelerated using electric fields: Conor Maher-McWillams and colleagues show that atoms can also be accelerated using strong optical fields.

The idea behind the laser-driven linear accelerator designed by Maher-McWillams *et al.* is intuitive — atoms catch the optical waves created by the interference of two intense counter-propagating laser beams. As the waves pass through an atomic cloud, they accelerate batches of atoms that have the right initial positions and velocities, and by tuning the intensity and frequency of the lasers — tuning the waves — one can control the final velocity of the atoms. In their experiment, Maher-McWillams *et al.* accelerated argon atoms to velocities of hundreds of metres per second over micrometre distances in tens of nanoseconds.

Optical-wave surfing is not restricted to atoms. The technique could also be applied to a variety of molecular species, nanoscale particles and exotic atoms such as positronium and antihydrogen. *IG*

Wiggle room

Nature Commun. **3,** 801 (2012)

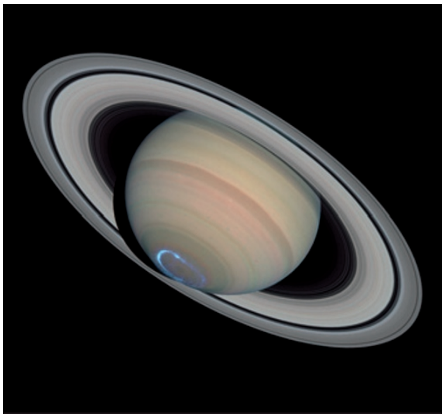
Sometimes a little Brownian motion is all you need: by looking at lithographic triangular platelets small enough to show substantial spatial and orientational fluctuations at room temperature, Kun Zhao and colleagues have uncovered local chiral symmetry breaking in a system of achiral polygons.

Packing problems are by no means immune to the unexpected. Spheres exhibit a spatial disorder–order transition at densities lower than those prohibiting translation, and disks betray a six-fold symmetry, with quasi-long-range orientational order — but only short-range spatial order. Shapes bearing significant anisotropies can even give rise to spatially disordered liquid crystal phases. But the idea that packing achiral shapes might induce chirality distinguishes the triangular system of Zhao *et al.* from previous studies, including the group's own survey of pentagonal and square packings.

The revelation that the symmetry breaking arises from a simple combination of entropy and geometry makes it all the more intriguing. The rotational entropy of the thermally excited particles favours a spatial ordering in which neighbours are laterally offset from one another. The ensuing chirality persists locally, and effects a spatial disordering on longer scales. This reduces the range of shapes that can be entropically crystallized, which in turn sets a limit on the set of structures that can be probed crystallographically. *AK*

Cyclones on Saturn

J. Geophys. Res. **117,** A04215 (2012)



© NASA/ESA/J. CLARKE (BOSTON UNIV.)/Z. LEVAY (STSCI)

Electromagnetic activity in Saturn's magnetosphere varies over a period that is almost, but not exactly, the same as the planet's 10.7-hour rotational period. The two may be linked, but correlation is not the same as causation. Moreover, Saturn's planetary magnetic field is well-aligned with its axis of rotation, so it isn't clear how its field and its rotation could be linked, even in principle.

Xianzhe Jia and colleagues suggest that they might be connected by long-lived disturbances in Saturn's upper atmosphere. They postulate the existence of cyclone-like features that drive perturbations of its ionosphere, which in turn interact with its magnetosphere and cause its electromagnetic activity to vary. Such features should rotate almost in time with the planet's rotation, but lag slightly behind.

Magnetohydrodynamic simulations by Jia *et al.* reproduce much of the periodic behaviour observed in Saturn's magnetosphere, and the authors argue that this is the most comprehensive explanation so far. However, it remains to be seen whether the ionospheric cyclones they postulate actually exist. *EG*

Structurally sound

Appl. Phys. Lett. **100,** 191901 (2012)

It is possible to engineer a material so that it gives a desired response to an incoming wave — such as the metamaterials that can manipulate electromagnetic waves to create 'invisibility cloaks'. The same idea is equally applicable to mechanical waves or sound. Muamer Kadic and co-workers have now devised a metamaterial that could be the basis of an acoustic cloak.

In 1995, scientists showed theoretically that an array of structures known as pentamodes could create a metamaterial with any conceivable mechanical property, with each pentamode comprising eight cones placed end to end. But a structure that balances cones point-to-point is obviously unstable, and so such a metamaterial has proven impossible to realize in practice.

Kadic *et al.* show that modifying this idea so that the cones are slightly truncated gives a structure that is both producible and has the required mechanical properties. They created the material from a block of polymer using a process known as direct-laser-writing optical lithography. The technique is sensitive enough to produce pentamodes with a truncated-end diameter as small as 0.55 micrometres. *DG*

Written by Iulia Georgescu, Ed Gerstner, David Gevaux, Abigail Klopper and Alison Wright.