ACTIVE COLLOIDS

Made to order

Proc. Natl Acad. Sci. USA http://dx.doi.org/10.1073/pnas.1513361112 (2015)

Living cells are adept at converting energy into motion. So what if we could borrow some of their genius to make our own tiny machines — systems capable of manipulating form and function with something as simple as an assembly of colloids? Matthew Spellings and co-workers have designed an active colloidal cell: a fluid-filled compartment made up of rotating particles that generate convective flows.

The team proposed and simulated a system comprising particles that could translate and rotate in two dimensions, and were confined by a flexible boundary built from similar particles. The boundary acted to stir the flow inside the cell, interfering with the phase separation expected of these particles in the bulk. They found that this convective activity allowed them to control the cell's shape and structure, simply by altering its physical properties — the flexibility of the boundary and the particles' activity. *AK*

PRECISION MEASUREMENTS

Symmetry unchallenged

Nature Commun. http://dx.doi.org/10.1038/ncomms9174 (2015)

The hunt for new physics — or hints of the elusive relationship between quantum mechanics and general relativity — relies on spotting tiny violations of known principles such as Lorentz invariance. But no such illegal activity has yet been reported, which motivated Moritz Nagel and colleagues to use the latest technologies in a modern Michelson–Morley-style experiment to perform the most precise measurement of the spatial isotropy of the speed of light.

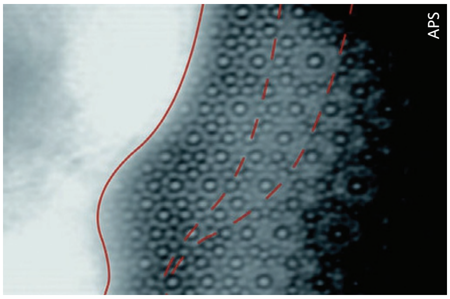
In the original Michelson–Morley experiment, the interference pattern of light travelling along the two perpendicular arms of an interferometer and back would betray any change in the speed of light due to its motion relative to the aether. In the modern version, reported by Nagel *et al.*, any anisotropy in the speed of light would be reflected in the modification of the beat note frequency between two orthogonal ultrastable oscillators.

A year's worth of data checking for various rotations, both artificial and those due to the Earth's movement, constrained the fractional frequency change below 10^{-18} — ruling out any sign of Lorentz symmetry violation: either a reassuring or disappointing result, depending on your taste. *IG*

QUASICRYSTALS

Relaxing defects

Phys. Rev. Lett. **115,** 075501 (2015)



APS

Quasicrystals defy translational periodicity — you can't construct one by adding identical unit cells along three crystallographic directions. So how do they grow?

Keisuke Nagao and colleagues addressed this puzzle by looking at the structural evolution of a well-known quasicrystal former (a decagonal Al–Ni–Co alloy) when heated, in a transmission electron microscope. The authors recorded and analysed a series of high-resolution images over a period of 15 seconds (pictured).

Prior to heating, the sample consisted of many quasicrystalline grains with different orientations. In their *in situ*, high-temperature imaging experiments, the authors observed one grain 'eating' a neighbouring grain. They found that growth into a defect-free single quasicrystal occurs through error-and-repair events. A so-called phason defect arises because an atom occupies a position prescribed by local interactions; the defects are then corrected through phason relaxation, which can be achieved by a rearrangement of the quasicrystalline tile structure.

Importantly, these observations show that quasicrystals can form via a mechanism independent of nonlocal interactions. The alternative implies that atoms are 'aware' of a global structure-defining force, which is indeed difficult to motivate from a physics point of view. *BV*

SUPERCONDUCTIVITY

The pressure to succeed

Nature http://dx.doi.org/10.1038/nature14964 (2015)

For 22 years, a mercury-based copper-oxide superconductor has held the highest transition-temperature record of 164 K, under pressure. We still do not understand the mechanism of superconductivity in the cuprates, or how to increase the transition temperature in these exotic superconductors. It is thus truly exciting that A. P. Drozdov and co-workers now report 203 K superconductivity in a sulfur hydride above 90 GPa. Moreover, the superconductivity seems to be conventional, mediated by electron–phonon coupling as described by Bardeen–Cooper–Schrieffer (BCS) theory.

With such a small sample trapped in a diamond anvil cell, it is difficult to ascertain the exact compound of interest here. Metallic hydrogen is a tantalizing possibility, but H_3S is the more likely candidate. It is a good metal and has strong covalent bonding between H and S. Although hydrides are usually insulators, doping or gating could be a way to drive them to behave like metals at ambient pressure. As BCS superconductivity puts no upper limit on transition temperatures, who knows what the future will hold? *MC*

TOPOLOGICAL PHOTONICS

Go Weyl'd

Science **349,** 622–624 (2015)

Graphene has a range of fascinating electronic properties that arise from the massless relativistic nature of the electrons. Photonic graphene — the optical equivalent with electrons in place of light — has equally intriguing properties, but these systems are both intrinsically two dimensional. What about their three-dimensional counterparts?

Graphene-like crystals are zero-bandgap materials whose dispersion relation is linear at high-symmetry Dirac points. To maintain this linear relationship in 3D is tricky, as the points, which are known as Weyl points, become unstable. Ling Lu and co-workers, however, have now confirmed their earlier predictions and observed Weyl points in a photonic crystal.

To make Weyl points, you need to break parity–time symmetry. To do this, Lu *et al.* used a double-gyroid structure that breaks inversion symmetry (parity) while maintaining time-reversal symmetry. The resulting Weyl points are topologically protected, and were observed using microwave transmission measurements. And there is some evidence that this approach could be extended to optical wavelengths.

Aside from opening the door to 3D topological photonics, these observations compliment simultaneous reports of Weyl points in the solid state, bringing the 85-year Weyl search to an end. *LF*

Written by May Chiao, Luke Fleet, Iulia Georgescu, Abigail Klopper and Bart Verberck.