CONDENSED-MATTER PHYSICS
Weyl metamaterials
Phys. Rev. X **7,** 041026 (2017)

Metamaterials modify the properties of light — bending and shaping it to yield media with exotic capabilities. The earliest metamaterials were designed many decades ago, but so far most have been tailored to modify electromagnetic radiation or sound. Now, Alex Weström and Teemu Ojanen have reapplied this concept to the movement of electrons through conducting crystals.

Instead of changing the permeability and permittivity of the crystal, Weström and Ojanen theoretically proposed that introducing carefully configured perturbations would warp the background against which the electrons move. This is akin to the curving of spacetime by massive objects that produce a gravitational field. If designed correctly, a three-dimensional lens could bend the path of the electrons to periodically focus them at a series of distant points.

Candidate materials include Weyl semimetals, which host relativistic electrons. The warping could be induced by strain, magnetic dopants or layer-by-layer material design. The idea could even be extended to 'cloak' regions of the crystal, rendering them invisible to electrical current. More fundamentally, condensed-matter analogues of phenomena such as black holes could now be within reach. *DA*

ICE NUCLEATION
Rain before six
Nature **551,** 218–222 (2017)

The six-fold symmetry of snowflakes is a never-ceasing source of marvel and wonder. For bulk ice, six is also the number of choice — the hexagonal crystal form provides the highest stability at ambient pressure. But nanoscopic ice breaks that pattern, as Laura Lupi and colleagues report. In numerical simulations, they found that for crystallites of up to at least 100,000 molecules, ice with randomly mixed layers of cubic and hexagonal symmetry is the most stable form.

The thermodynamic preference for such stacking disorder is important. Classical nucleation theory assumes that the initially formed 'ice embryo' consists of hexagonal ice. For stacking-disordered crystallites, however, nucleation rates can be three orders of magnitude faster, Lupi *et al.* found. Such accelerated nucleation, in which the crystallites continuously cross over to the hexagonal configuration, should occur in particular in conditions relevant to clouds. And as freezing typically initiates precipitation, the effect of stacking disorder in ice nucleation ought to be taken into account for accurate weather and climate forecasts. *AHT*

QUANTUM SPIN LIQUIDS
To be or not to be
Nat. Commun. **8,** 1152 (2017)

In an ordered spin system, the spectrum for collective excitations of the spin structure is discretized, the corresponding quasiparticles being magnons. However, magnets subject to strong spin–orbital coupling, such as α-$RuCl_3$, provide striking counterexamples. Their magnetic excitations form a continuum inconsistent with magnon descriptions. It is often thought that these are the coherent fractional excitations expected in the celebrated Kitaev spin liquid — a peculiar state displaying no long-range order down to zero temperature.

But now, Stephen Winter and colleagues have suggested that the observed continua could instead originate from non-Kitaev interactions naturally present in the low-symmetry crystalline environment of real materials. This scenario leads to incoherent excitations, and fully explains the inelastic magnetic response of α-$RuCl_3$ recently observed in neutron scattering experiments. The conditions under which the magnons break down due to these interactions were identified, revealing that nontrivial excitations persist well beyond the Kitaev spin liquid. As the knowledge of the underlying interactions is still incomplete, we still have a way to go before we can claim to have fully characterized the nature of excitations. *YL*

FLOCKING
Cloud of bugs
Phys. Rev. Lett. **119,** 178003 (2017)

As if the beauty of the landscape weren't enough, flocks of birds turn sunsets above Mediterranean cities into breath-taking spectacles. Ever shrinking and expanding, flocks appear in urban skies as dark and unpredictable clouds — fascinating physicists attempting to understand this elegant display of collective dynamics. In an effort to describe such behaviour, Michael Sinhuber and Nicholas Ouellette have now shown that flocks might be more similar to clouds than one would imagine.

The researchers studied swarms of *Chironomus riparius* midges and, by reconstructing the three-dimensional trajectories of individual midges, they looked for truly collective features. Inspired by thermodynamic concepts that bear no meaning at the individual level, Sinhuber and Ouellette demonstrated that swarms could be described as two thermodynamic-like states at equilibrium: a condensed phase surrounded by a cloud of vapour. The unpredictable movements of individual midges proved the collective nature of this description, as they could freely move between the two phases without altering their global macroscopic properties. Hopefully, without stripping sunsets of their beauty, this might be a way to apply active-matter theories to animal behaviour. *FL*

BIOMATERIALS
Spidey sense
Proc. Natl Acad. Sci. USA **114,** 12120–12125 (2017)


FRANK CHMURA / ALAMY STOCK PHOTO

Man-made flow sensors trade sensitivity for bandwidth — or vice versa — and typically meet limitations on small length scales due to their size and power consumption. Nature, by contrast, boasts myriad sensors that outperform our best efforts. And now, Jian Zhou and Ronald Miles have demonstrated that spider silk (pictured) may offer the most efficient example to date, claiming the sensitivity of an ideal resonant sensor without succumbing to the usual bandwidth limitations.

Zhou and Miles recorded sound from the motion of a strand of spider silk subjected to acoustic signals that ranged in frequency from the beating of an insect's wings all the way up to birdsong. A laser vibrometer measured the motion, which was found to capture the broadband acoustic signals with high fidelity. The implication is that a spider may be capable of processing an acoustic signal — be it from a potential mate or an incoming predator — directly through its web. *AK*

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