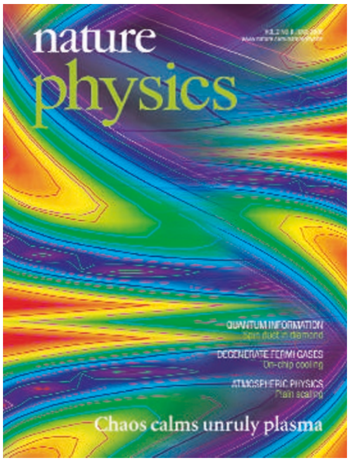

COVER STORY

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Plasma instabilities known as edge-localized modes represent a significant challenge to the development of magnetically confined fusion as a clean, sustainable energy source. These instabilities are caused by the build-up of energy at the edge of toroidal plasmas produced in the so-called high-confinement mode, and result in the rapid discharge of energy to the walls of the chamber in which they are held. This in turn causes significant erosion of the walls, requiring their frequent replacement, which could severely limit the operation and viability of any future fusion reactor. But Todd Evans and colleagues may have found a solution. By weakly perturbing the edge of the magnetic field that confines a fusion plasma in a way that causes the field lines to become chaotic, these catastrophic modes can be all but eliminated. **[Article p419; News and Views p369]**

BRILLIANT TWOSOME

Nitrogen-vacancy (NV) defects in diamond have several features that make them a promising prospect for quantum-information processing, including relatively long spin lifetimes, even at room-temperature, and the possibility to read out single spins optically. Torsten Gaebel and colleagues now push the limits on several fronts, by carefully implanting nitrogen atoms and molecules into ultrapure diamond. In isolated NV defects, they observe record phase-coherence times. One spin is good, two are better: Gaebel *et al.* go on to transform N_2 molecules into closely spaced spin pairs. Coherent coupling and polarization transfer are shown in this engineered two-spin system, demonstrating the ability to create pairs of single quantum objects in a solid host and control them under ambient conditions.
[Article p408; News and Views p365]

LIGHT AND SOUND

Rarely do light and sound interact. This is because photons carry lots of energy but little momentum, and phonons carry lots of momentum but little energy, making it difficult for any such interaction to conserve both quantities simultaneously. But when certain acoustic modes cause small periodic variations in the refractive index of an optic fibre, they can cause light travelling within the fibre to be scattered. By more tightly confining light and sound within the micrometre-diameter core of a nanostructured photonic-crystal fibre, Paulo Dainese and colleagues find that this interaction can be enhanced. Moreover, by varying the diameter of the fibre's core they can alter the dispersion of the acoustic modes present and thereby change how they interact with the light.
[Letter p388]

TWO-LIQUIDS BETTER THAN ONE?

Water behaves differently from other materials — take, for example, its expansion on freezing. One approach to explaining such behaviour is the 'two-liquid model' that predicts a second critical point near 220 K and 100 MPa. This region, however, lies below the minimal freezing temperature of water and is therefore not directly accessible. Instead, experimental evidence for the second critical point has been sought from transitions between different forms of amorphous ices. However, whether the transition is discontinuous, as required by a two-liquid model, or continuous is still debated. Richard Nelmes and co-workers now bring a so-far uncharacterized form of amorphous ice into the game, and the behaviour seen in their samples clearly supports the two-liquid model. **[Article p414]**

LET'S TALK ABOUT THE WEATHER

Weather is a universal topic, whether it's dull or catastrophic. But universality in weather? The concept of universality is usually discussed in the context of statistical mechanics, in which physical quantities follow scaling laws with universal exponents near phase transitions and critical points. Such critical phenomena are usually observed on length scales of micrometres, in magnets for example. By considering the vapour content of precipitation in the tropics, Ole Peters and David Neelin have found long-range correlated behaviour in atmospheric convection — up to hundreds of kilometres. As the water vapour passes a critical value, the precipitation undergoes a continuous phase transition to a state of intense rain. When the mean water vapour value hovers close to critical, the system displays self-organized criticality, such as that found in avalanches.
[Letter p393; News and Views p374]

Up in the clouds: long-range correlations and universal scaling.

p393

FERMI GAS COOLED ON A CHIP

Degenerate Fermi gases provide a promising means to explore fundamental interactions and obtain valuable insights into the behaviour of many important systems including neutron stars, high-temperature superconductors and the quark–gluon plasma of the early Universe. But the bulk and complexity of the equipment needed to produce them — unlike their cousins, Bose–Einstein condensates — has meant that only a handful of labs around the world have been able to study them. To address this, Seth Aubin and colleagues have developed an approach that uses a relatively simple magnetic microtrap, fabricated on the surface of a so-called atom chip, to cool a gas of potassium-40 atoms to its Fermi-degeneracy point. As well as making degenerate Fermi gases easier to produce, this approach could facilitate their use in precision atom interferometry and quantum-information processing.
[Letter p384; News and Views p377]