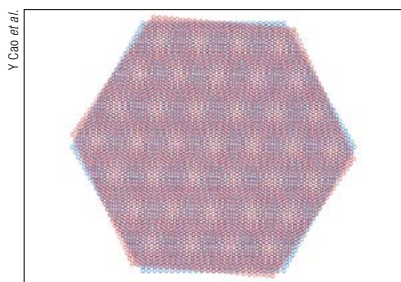


Sciencewatch

COMPILED BY JOHN SWAIN, NORTHEASTERN UNIVERSITY

Graphene is also a superconductor

Graphene, the one-atom-thick sheet of carbon atoms, continues to provide surprises with possibly enormous implications. Yuan Cao from MIT and colleagues show that a stack of two graphene layers can conduct electrons with zero resistance if the layers are twisted at a “magic angle” of 1.1° — a discovery that could be a step towards room-temperature superconductors. The material still needs to be cooled to 1.7 K, but the results indicate that it may superconduct in a

Y Cao *et al.*

A stack of two graphene layers superconducts if the layers are twisted at a “magic angle”.

way similar to high-temperature cuprates and point the way towards higher superconducting temperatures. Details of exactly what is taking place are being worked out.

● Further reading

Y Cao *et al.* 2018 *Nature* **556** 43.

Continuous-wave maser

Masers — the microwave analogues of lasers — have not seen the degree of use one might expect because they have long required cryogenics and high-vacuum systems. The development of room-temperature solid-state masers based on pentacene molecules in a *p*-terphenyl host in 2012 was a breakthrough, but the poor mechanical and thermal properties of *p*-terphenyl have restricted these masers to pulsed mode. Now, Jonathan Breeze of Imperial College London and colleagues have demonstrated the first continuous-wave room-temperature maser oscillator using optically pumped nitrogen-vacancy defect centres in diamond at 9.2 GHz. Immediate applications include radio astronomy and deep-space communications.

● Further reading

J D Breeze *et al.* 2018 *Nature* **555** 493.

Modifying nuclear decay rates

It is well known that the spontaneous emission rates of atoms or molecules can be modified by changing their electromagnetic environment, which is typically an optical cavity. But the same is hard to achieve for nuclear transitions because the frequency of the radiation emitted in most nuclear transitions is much larger than that of the cavity modes. Eugene Tkalya of Moscow State University now predicts that the decay rate via emission of ^{229}Th from its lowest excited nuclear state can be increased or decreased by an order of magnitude by placing the atom in a dielectric sphere or a thin film. The effect could lead to ultraprecise atomic clocks based on nuclear transitions.

● Further reading

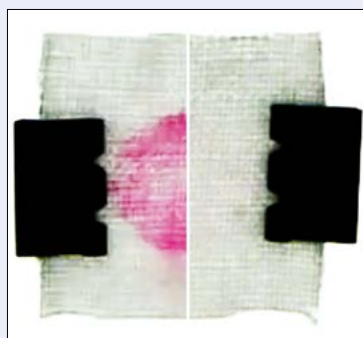
EV Tkalya 2018 *Phys. Rev. Lett.* **120** 122501.

Laundry physics

Physics usually tackles big questions, but smaller everyday ones can also be interesting. Sangwoo Shin of the University of Hawaii at Manoa and colleagues have solved a long-standing problem in laundry detergency called the stagnant core problem — figuring out how detergent gets stain particles out from between tightly wound fibres, where water flow is restricted. Shin *et al.* explain this by the migration of particles along a concentration gradient, a process that is far more effective than naive solute diffusion. This manifests as stain particles being removed from cloth far better by rinsing soapy fabric in fresh water than in detergent-filled water — an insight with potentially wide industrial applications, and perhaps something to think about the next time you do laundry.

● Further reading

S Shin *et al.* 2018 *Phys. Rev. Appl.* **9** 034102.



Rinsing soapy fabric in fresh water (right) gets stain particles out far better than rinsing in detergent-filled water (left).

Superionic ice

It has been suggested that water ice under high pressure, such as inside planets, would be superionic, with liquid-like hydrogen ions moving inside a solid lattice of oxygen. Now, Marius Millot of Lawrence Livermore National Laboratory and colleagues report laser-driven shock-compression of ice VII and find melting near 5000 K at 190 GPa. A variety of measurements, including optical reflectivity and absorption measurements, show a low electronic conductivity, which, together with previous measurements, provides evidence for superionic ice under planetary-interior conditions, verifying a prediction dating back 30 years.

● Further reading

M Millot *et al.* 2018 *Nat. Phys.* **14** 297.

Gamma-ray lasing

Gamma-ray lasers have been elusive because it's hard to produce coherent gamma rays. Now, Luca Marmugi of University College London and colleagues have identified a gamma-ray lasing mechanism in a Bose–Einstein condensate (BEC) of ^{135}Cs atoms in their isomeric state, $^{135\text{m}}\text{Cs}$, that could be implemented with existing techniques. The mechanism is triggered by the spontaneous emission of one gamma photon, and relies on the transfer of the coherence of the BEC to the photon field. The $^{135\text{m}}\text{Cs}$ atoms can be made from proton-induced fission of actinides, followed by neutralisation, laser cooling and trapping. Standard techniques should allow trapping only of atoms in the desired state, so that a total population inversion is achieved.

● Further reading

L Marmugi *et al.* 2018 *Phys. Lett. B* **777** 281.

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