

Sciencewatch

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Why seahorses have square tails

Most animals have tails with round cross-sections, but tails of seahorses have square ones. Michael Porter of Clemson University in South Carolina and colleagues have now explained why. Using 3D printing to make articulated models of square and circular tails and test them, they found that while cylindrical tails could twist better, the square cross-section provides more contact area and helps the tail to relax, reducing the energy the animal has to expend to grasp things. The square cross-section is also



three times stiffer and four times stronger under compression.



Why do seahorses, left, have square tails? A tail with square segments, right, creates more contact points with the surface that it is gripping, compared with a tail that has round segments. (Image credits: Florin Dumitrescu, left, and Michael Porter/Clemson University.)

● Further reading

MM Porter *et al.* 2015 *Science* **349**aaa6683-1.

Metal deuterium

It has long been suggested that hydrogen, under enough pressure, would become metallic, and this transition has now been seen, at least in deuterium. Marcus Knudson of Sandia National Laboratories in New Mexico and colleagues used the Sandia Z machine, which can produce currents of 20 MA and magnetic fields of 10 MG, to produce shock waves via an aluminium plate to squeeze liquid deuterium by more than 300 GPa for around a tenth of a microsecond. Between 280–305 GPa, there was an abrupt transition to a shiny metallic state. Standard hydrogen may take more effort, but this gives plenty of insight into how solid hydrogen might behave, with significant implications for ideas about gas-giant planets such as Jupiter.

● Further reading

MD Knudson *et al.* 2015 *Science* **348**1455.

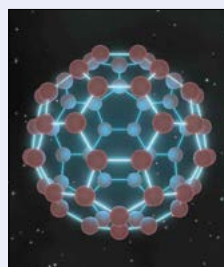
Bacteria make superfluids

Genuine superfluidity is normally associated with extreme cold, but zero viscosity has come about in an unexpected way, thanks to bacteria. Harold Auradou of the University of Paris-Sud and colleagues have found that a solution with *Escherichia coli* swimming in it had a shear viscosity that depended on the concentration of bacteria. Above a threshold, they saw a “superfluid-like” transition where, macroscopically, the self-organized swimming of the bacteria overcame the dissipative effects arising from viscous loss.

● Further reading

HM Lopez *et al.* 2015 *Phys. Rev. Lett.* **115**028301.

Buckyballs in space



Buckyballs are famous for their soccer-ball-like structure, with 60 carbon atoms. (Image credit: NASA/JPL-Caltech.)

Numerous “diffuse interstellar bands” (DIBs) in the absorption spectra of the interstellar medium have been puzzling astronomers since their discovery nearly 100 years ago. Now, thanks to Ewen Campbell of the University of Basel and colleagues, two infrared lines (at 9632.7 ± 0.1 and 9577.5 ± 0.1 Å) have been matched up with laboratory measurements of spectra of the buckminsterfullerene or “buckyball” ion C_{60}^+ in the gas phase cooled to 5.6 K. Buckminsterfullerene has a low ionization potential, so finding it as an ion is not surprising, but the origin of the molecule itself in space and the nature of the rest of the DIBs are still mysterious.

● Further reading

EK Campbell *et al.* 2015 *Nature* **523**322.

Weyl point seen

Back in 1929, Hermann Weyl proposed an equation for massless particles with a conical point in its dispersion relation –

the “tip” of the mass shell, also called the “Weyl point”. Neutrinos have mass, so do not fit his equation, but now the Weyl point has turned up in a solid-state system.

Following earlier theoretical suggestions, Su-Yang Xu of Princeton University and colleagues used photoemission spectroscopy to show that TaAs is a Weyl semimetal, with Weyl fermions as emergent quasiparticles. They clearly demonstrated Weyl cones and the Weyl point for propagation in the bulk, as well as Fermi arcs on the surface. The work is generating great excitement because this is, in many ways, a 3D analogue of graphene, and promises a range of applications.

● Further reading

S-Y Xu *et al.* 2015 *Science* DOI: 10.1126/science.aaa9297.

Mining waste

Sewage in the US could be a useful source of high-value metals. Paul Westerhoff of Arizona State University and colleagues have found that the amounts of the 13 most lucrative elements – Ag, Cu, Au, P, Fe, Pd, Mn, Zn, Ir, Al, Cd, Ti, Ga and Cr – add up to be worth a total of \$280 for each tonne of sludge. This corresponds to around \$8 million per million people, or more than \$2.5 billion per year for the country as a whole. The metals enter the wastewater system from a variety of industries and the challenge will be to extract them from the sludge in an economical way.

● Further reading

P Westerhoff *et al.* 2015 *Environ. Sci. Technol.* 10.1021/es505329q.

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