Sciencewatch

Compiled by John Swain, Northeastern University

Sliding over wet sand

Sliding on sand has important implications in areas from civil engineering to earthquake dynamics. It also has some glamour, because wall paintings found by archaeologists suggest that wetting of sand was important for construction in ancient Egypt. Daniel Bonn of the University of Amsterdam and colleagues have made a careful experimental study, and show that small amounts of water – but not a great deal – can dramatically reduce sliding friction. The force needed to get a wooden sled to move can be reduced by up to 70% and the force to keep it going at constant speed can be reduced by 40%.

They find that the formation of capillary water bridges increases the shear modulus and helps sliding, but too much water makes these bridges coalesce. Then the friction increases and can be higher than for dry sand. For appropriate amounts of water, sliding over wet sand can be as good as when wooden "sleepers" are used to reduce friction.

Wall painting in the tomb of Djehutihotep, 1800 BC. The figure standing at the front of the sled is pouring water onto the sand.

Further reading

A Fall *et al.* 2014 *Phys. Rev. Lett.* **121** 175502.

Twin Earth found

Astronomers have found the first Earth-sized planet where liquid water could exist. Elisa Quintana of the SETI Institute in Mountain View, California, and the NASA Ames Research Center in Moffett Field nearby, used the Kepler Space Telescope to search around the constellations Cygnus and Lyra. The aim was to find planets via their dimming effect on the stars they orbit as they pass in front.

In this way, the researchers discovered Kepler-186f, a planet that is 1.1 times the size of the Earth and orbiting an M-dwarf star. This star is cooler and dimmer than the Sun, but the planet is at a distance that should allow for liquid water on the surface if the atmosphere has enough carbon dioxide to keep it sufficiently warm – a case where global warming might be a good thing, arguably. The planet is about 500 light-years away, and is the closest to an Earth-like planet found so far.

Further reading

E V Quintana *et al.* 2014 *Science* **344** 277.

Stable hidden states

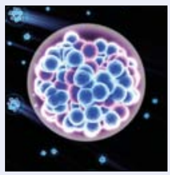
The equilibrium phase diagram of a material might not reflect all of the states in which it can appear. Hidden states can result from a system out of equilibrium. L Stojchevska of the Jožef Stefan Institute in Ljubljana and colleagues have shown that it is possible to switch to such hidden states and that they can be stable.

The group used a 35 s laser pulse on a layered dichalcogenide crystal of the trigonal state of tantalum disulphide to knock it into a hidden state that has a much lower electrical resistance, modified single particle and collective mode spectra and a large change in optical reflectivity. The state is stable until another laser pulse, an electrical current, or heat is applied. As a potential memory device, this beats the current speed record of 40 fs in magnetic materials.

Further reading

L Stojchevska *et al.* 2014 *Science* **344** 177.

Towards the island of stability



Element 117. (Image credit: Kwei-Yu Chu/ LLNL)

The famous "island of stability", hypothesized for transuranic elements around the region where the number of neutrons in the nucleus N = 178 and the number of protons Z = 118, might be in sight. Jadambaa Khuyagbaatar of the Helmholz Institute Mainz and GSI in Darmstadt and colleagues produced nuclei with Z = 117 in ^{48}Ca + ^{249}Bk fusion events at the gas-filled recoil separator TASCA at GSI. Two decay chains associated with ^{294}117 were identified and a new α decay of ^{270}Db (Z = 105) to a new isotope ^{266}Lr (Z = 103) was found with a half-life of $1.0^{+1.9}_{-0.4}$ hours. This is a longer lifetime than any α-decaying nucleus heavier than nobelium (Z = 102), and far longer than the half-lives of approximately 2 min of ^{269}Sg and ^{271}Sg, the longest-lived α-decaying superheavy elements previously known.

Further reading

J Khuyagbaatar *et al.* 2014 *Phys. Rev. Lett.* **112** 172501.

Where the xenon went

More than 90% of the xenon expected in the Earth's atmosphere appears to be missing, and while most researchers think that it must be hidden within the planet, all attempts to find a suitable reservoir, such as ice, clathrates, sediments, or silica in the mantle, have failed. However, Li Zhu of Jilin Univeristy in Changchun and University College London and colleagues might now have found its hiding place. They calculate that under the temperatures and pressures at the Earth's core, xenon is expected to react with iron and nickel to form $XeFe_3$ and $XeNi_3$ and other compounds, making the core the likely hiding place of this noble gas.

Further reading

L Zhu *et al.* 2014 *Nature Chemistry* doi:10.1038/nchem.1925.

Designer chromosome

Another breakthrough in synthetic biology is in the title of the paper "Total synthesis of a functional designer eukaryotic chromosome". Narayana Annaluru of Johns Hopkins University in Baltimore and colleagues synthesized an entire chromosome, synIII, with 272,871 base pairs. The synthetic chromosome is based on chromosome III of the native *Saccharomyces cervisiae* yeast – commonly used in baking and brewing – which has 316,617 base pairs, but leaving out genes that appear to be inessential. Placed into yeast, the chromosome seems to work fine, opening the door to designer eukaryotic genome biology.

Further reading

N Annaluru *et al.* 2014 *Science* **344** 55.
