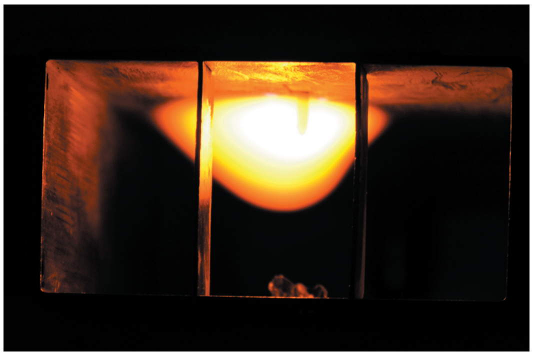
Great balls of fire!


ELI JERBY

On Tuesday 3 August 1982, Cambridge University's Cavendish Laboratory was struck by lightning. Although no serious damage was caused, according to Sir Brian Pippard an assistant on the ground floor was startled by "a bright sparkling object ... that entered [a small window] by her head, rebounded from a machine and left as it came" (*Nature* **298**, 702; 1982).

Despite this and many other historical accounts, the phenomenon of 'ball lightning' has remained largely the stuff of myth. But Vladimir Dikhtyar and Eli Jerby's demonstration of the behaviour of fire balls generated by an industrial 'microwave drill' could provide an explanation (*Phys. Rev. Lett.* **96**, 045002; 2006).

Such fire balls (pictured) mimic two of the most perplexing aspects of ball lightning — they persist after the initial source of energy is removed and they float in air. This supports previous suggestions that ball lightning could be driven by the oxidation of particles in a cloud generated by an energetic event, such as a conventional lightning strike.

Colour effect

The mass of the *W* boson is 80.415 ± 0.042 ± 0.030 ± 0.009 GeV, according to the OPAL collaboration (*Eur. Phys. J. C* **45**, 307–335; 2006). One of four experiments at CERN's former Large Electron Positron (LEP) collider, OPAL is the first to produce its final measurement of this fundamental quantity in particle physics.

That data-taking at LEP ended in 2000 gives some indication of the difficulty in pinning down the *W* mass by direct measurement (to test the precise inferred value, which constrains the mass of that other boson, the Higgs). The first error quoted by OPAL is statistical; the third reflects the uncertainty in the centre-of-mass energy of the e^+e^- collisions in the 27-km LEP ring.

The remaining, systematic error includes, alongside predictable detector effects, a contribution from final-state interactions, such as colour reconnection. This arises when each *W* boson, produced pairwise in e^+e^- annihilation above 160 GeV, decays into a pair of quarks. The colour forces between the quarks can lead to gluon exchange, a reconnection that effectively blurs the information from which the *W* mass is reconstructed. Frustratingly, there is no firm evidence in the LEP data that reconnection is taking place, but as it is established in other systems the effect must be taken into account in the *W*-mass error.

Four strikes and you're in motion

The four-stroke cycle is the most common sequence used in combustion engines. Now Vincenzo Balzani and co-workers present an artificial molecular motor — only some five nanometres in length — working to a similar rhythm (*Proc. Natl Acad. Sci. USA* **103**, 1178–1183; 2006).

Instead of moving valves and pistons, the four-stroke nanomotor is a rotaxane molecule, in which a ring encircling a dumbbell-shaped structure moves back and forth between two stations placed 1.3 nm apart. The shuttling is induced by light excitation. At the end of the cycle, the initial configuration is restored, and the process can start over again. In these experiments, the motor ran in a stable manner for at least 1,000 cycles, at a frequency of 1,000 Hz, generating a power of about 10^{-17} W per molecule.

Conveniently, sunlight can serve as the sole energy source, and as long as the nanomotors are exposed to it, they keep operating autonomously, without producing waste products.

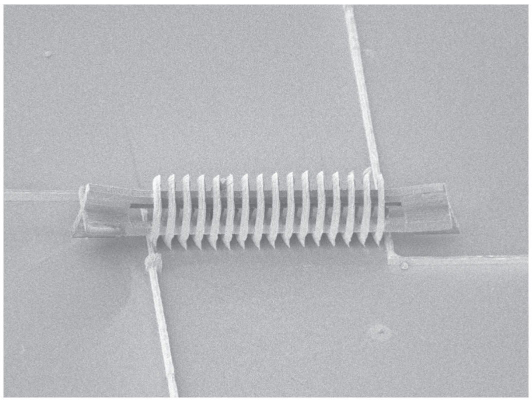
NUCLEAR HALO SLIPS IN CHARGE-RADIUS CHANGE

In the 1980s, ^{11}Li nuclei were found to have a 'halo' of two neutrons that orbit a ^{9}Li core. Halos have since been discovered in other nuclei but many details of the structure of ^{11}Li, such as the distribution of the three protons in the core, have not been fully understood. Rodolfo Sanchez and colleagues have now determined the charge radius of this nucleus, by measuring the frequency of 2*s*–3*s* transitions in neutral ^{11}Li atoms, and comparing the results with theory and data for other isotopes (*Phys. Rev. Lett.* **96**, 033002; 2006).

Most of the isotope shift measured in the experiment comes from the difference in the mass of the nuclei, but there are also small contributions due to changes in the volume and proton distribution, as well as quantum and relativistic effects. When all of these are accounted for, the charge radius of ^{11}Li is found to be 2.467 fm — which is larger than ^{9}Li (2.217 fm) but smaller than ^{6}Li (2.517 fm). The results suggest that the halo neutrons excite the core and change the charge radius, even though they spend half their time beyond the reach of the strong force that holds the nucleus together.

Small-world induction

Complex three-dimensional structures can be crafted on the microscale by multiphoton absorption polymerization (MAP): laser light is focused on a resin containing a 'photoinitiator', which is excited whenever two or more photons arrive simultaneously at a single spot, leading to local polymerization; washing away the unpolymerized resin afterwards leaves behind the desired structure. But using the technique with materials other than polymers — to produce, for example, electrical structures — has proved difficult.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Writing in the *Journal of the American Chemical Society* (**128**, 1796–1797; 2006), Richard A. Farrer and colleagues report that the 'functionalization' of polymeric microstructures might be the way forward. They used two different types of polymers and deposited metal selectively on one of them, to fabricate a tiny inductor (pictured). Roughly 100 μm in length, the device is formed from a copper-coated polymer; the supporting structure is made from the second polymer and lacks electrical functionality. Farrer *et al.* also fabricated wires and connected up the inductor, turning it into a functional device.