

## Implosive diagnosis

Laser-driven inertial confinement fusion is one of the leading approaches in generating energy from the fusion of hydrogen nuclei. It works by taking a spherical pellet containing deuterium and tritium, and irradiating it from all directions with a large number of high-energy laser beams, which compress and heat the pellet to the high temperatures and

pressures needed for the nuclei to fuse. It is expected that ignition of a self-sustaining fusion reaction will be achieved using this approach within the next five years, but doing so will require that a pellet be compressed with almost perfect symmetry.

To this end, Andrew Mackinnon and colleagues demonstrate a radiographic technique

that uses a pulsed beam of protons, in a manner similar to a stroboscopic light source, to capture an image of the shape and density of a pellet at a precise moment in time during its laser-driven implosion (*Phys. Rev. Lett.* **97**, 045001; 2006). Such diagnostic techniques are likely to be vital in optimizing the conditions needed for ignition.

## NUUDGE NUDGE, SQUEEZE SQUEEZE

Elements that superconduct now outnumber those that don't. Many have to be altered by means of strain or pressure before the electronic configuration becomes just right. The transition temperature,  $T_c$ , tends to be higher for elements with low atomic mass: lithium, the lightest metallic element, has the second highest — 20 K at 48 GPa. The new record is 25 K, report Takahiro Yabuuchi and co-workers (*J. Phys. Soc. Jpn.* **75**, 083703; 2006), who have squeezed calcium up to 161 GPa.

Signs of possible superconductivity in calcium 25 years ago, at 2 K and 44 GPa, have since been confirmed. Moreover,  $T_c$  increases with applied pressure, through several structural phase transitions. As with strontium and barium, the current belief is that pressure leads to the hybridization of *s* and *d* orbitals, such that the *d* orbitals near the Fermi level become populated, leading to superconductivity. In the high-pressure phase, the concomitant increase in the resistance suggests enhanced electron–phonon scattering. In principle, higher pressures should continue to enhance electron–phonon coupling and squeeze  $T_c$  to higher temperatures.

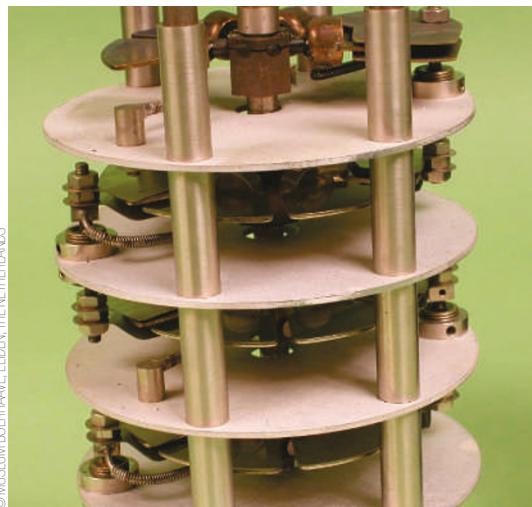
## More than a gedanken experiment

Following the celebrations of his *annus mirabilis*, there is no need to expand on the wonder of Albert Einstein's theoretical work. Less known, however, is his involvement in designing scientific instruments. One such instrument was devised

to measure small electrical potentials, and three original models of the apparatus still exist. Now, Danny Segers and Jos Uyttenhove (*Am. J. Phys.* **74**, 670–676; 2006) take a careful look at the inner workings (pictured) of this device that Einstein

fondly called *Maschinchen* — little machine.

Proposed by Einstein in 1908 and subsequently built by his friends the Habicht brothers, the instrument uses six stages of rotating plates that are first inductively charged, after which they transport their charge to an accumulator. The result, after several revolutions, is a multiplication of the initial potential. In principle, voltages as small as half a millivolt could be measured, and this might have enabled, for instance, the confirmation of the photoelectric effect. But the device suffered from interfering potentials, and was never blessed with success, commercially or scientifically. This, however, hardly distracts from the appeal that Einstein's *Maschinchen* still has.



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## At the weight limit?



Heavy nuclei tend to fission. But might there be certain nuclei — with proton numbers exceeding 100 — that show particular stability against decay, as the so-called magic-number nuclei do? A conclusive theoretical model for superheavy nuclei is yet to be established, so the experimental insight offered by Rolf-Dietmar Herzberg and colleagues (*Nature* doi:10.1038/nature05069; 2006) is particularly welcome, filling some of the gaps in understanding how heavy a nucleus could possibly exist.

Herzberg *et al.* watched nobelium-254 fall apart.

For this nucleus, which has 102 protons on board, a relatively high production rate of 200 atoms per hour was achieved, which allowed details of the decay path that remain inaccessible in other nuclei to be revealed. Moreover, the authors found evidence of excited structures in the nobelium-254 nucleus that involve the  $2f_{5/2}$  proton orbital, which is particularly interesting as it lies above a gap in shell energies predicted by certain theoretical models. These experimental data should now serve as a benchmark for the further development of such theories.

## Fine tuning

A quantum dot inside a photonic crystal microcavity can be an efficient source of single photons or entangled photon-pairs. However, owing to the random nature of a quantum dot's growth, spectral alignment of the light from the dot to an optical mode of the microcavity poses a significant challenge to the production of such devices. Temperature changes permit a small degree of spectral tuning, but at the expense of introducing decoherence. In addition, imperfections in the photonic crystal can split ideally degenerate modes, destroying the possibility of producing polarization-entangled photons.

K. Hennessy and colleagues have come up with a new method of post-fabrication tuning (*Appl. Phys. Lett.* **89**, 041118; 2006). By selectively oxidizing the surface of a cavity with the tip of an atomic force microscope, they can blueshift one of the split modes, thereby restoring the degeneracy. They are also able to spectrally shift both modes almost continuously by up to 4 nm. This could make it possible to tune to the narrow emission from a single quantum dot, and brings us closer to realizing an efficient, solid-state source of entangled photons.