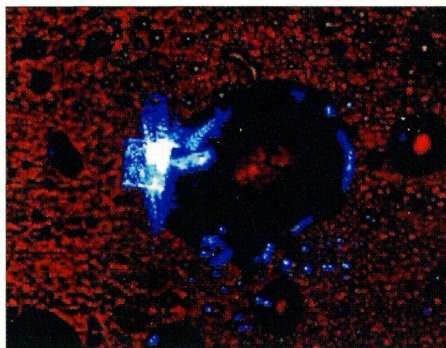


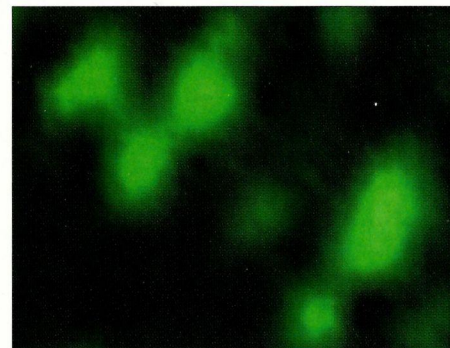
Plasmons make light work for microscopy

A clever new technique could allow biologists to study structures well below the wavelength of light without the need for complex devices such as electron microscopes. The idea in its first concrete implementation is simplicity itself. A sample is placed on a metal-coated glass surface and covered with a drop of glycerin. Laser light shines through the glass and produces surface plasmons (propagating optical modes) in the metal.

Broadly speaking, plasmons can be thought of as a kind of 2D light, with particles that are composites of electrons and photons. They have wavelengths of only about 70 nm, or about an order of magnitude less than visible light. In the new technique developed by Igor Smolyaninov and colleagues at the University of Maryland and Queen's University of Belfast, the glycerin acts like a parabolic dish that can collect plasmons sprayed out from the sample at its focal point. It then



A "plasmon microscope" formed with a glycerin drop (left) creates an image of a $30 \times 30 \mu\text{m}^2$ array of "nanoholes" (blue square), in which the triplets of the 100 nm diameter holes can be resolved (right).



forms them into something like a "plasmon beam" that goes back down towards the metal surface. Some of the photon part bounces back up and can be seen with a regular light microscope. The performance is close to what an electron microscope might

achieve, but involves no vacuum, high voltage or elaborate specimen preparation.

Further reading

Igor Smolyaninov *et al.* 2005 *Phys. Rev. Lett.* **94** 057401.

New explanation of why we live in 3D

Why do we live in three dimensions? This is an old question going back at least to Paul Ehrenfest who pointed out that neither classical nor quantum atoms are stable if space has more than three dimensions. String theory, which has made the idea of higher dimensions fashionable, usually solves the problem of explaining why we seem to live in three dimensions by arguing that extra dimensions might have curled up and become invisible.

More recent ideas propose that the particles that compose us are confined to 3D "branes", but again – why 3D? Now Ruth Durrer, Martin Kunz and Mairi Sakellariadou offer a new explanation. They say that string theory may naturally force all the higher-dimensional branes to unwind, leaving us sitting on a 3-brane, which we construe as the whole universe.

Further reading:

Ruth Durrer, Martin Kunz and Mairi Sakellariadou 2005 <http://xxx.lanl.gov/abs/hep-th/0501163>.

Researchers reveal secrets of stalactites

Physics has finally explained the dynamical origin of both stalactites (which hang down in caves) and stalagmites (the ones that grow up from the floor). A team at the University of Arizona has modelled these structures, known collectively as "speleotherms", as free-boundary problems involving water, calcium salts and carbon dioxide. The stalactites and stalagmites are attractors in the space of shapes of things that can grow, so these shapes are basically what must occur.

More precisely, the team derived a

geometric law of motion in which the growth rate depends on the local radius and inclination of the stalactite surface. They then used this to allow general initial conditions to evolve towards a universal shape, which they term the "Platonic ideal" of speleotherm growth. The team finds that the essential feature of the growth process is the locally varying fluid layer thickness, which controls the precipitation rate. In particular, this gives rise to an extreme amplification effect near the tip, which produces the characteristic slender form of stalactites.

Further reading

Martin B Short *et al.* 2005 *Phys. Rev. Lett.* **94** 018501.

A sticky business

Gecko lizards can hang from the ceiling by a single toe, thanks to their finely structured feet made of tiny fibres. These allow for huge areas, and thus huge van der Waals forces. But what happens if their feet get dirty?

W R Hansen and K Autumn of Lewis and Clark College in Portland, Oregon, have found that the fibres are so small that most of the time the adhesive forces between a surface

(e.g. a ceiling) and dirt are larger than the fibres can overcome. In effect, the feet of the geckos clean themselves as the lizards walk along. The new realization that you can have a very sticky yet self-cleaning surface could revolutionize "biomimetic" robotics, which aims at developing robots inspired by biology.

Further reading

W R Hansen and K Autumn 2005 *Proceedings of the National Academy of Sciences* **102** 385.

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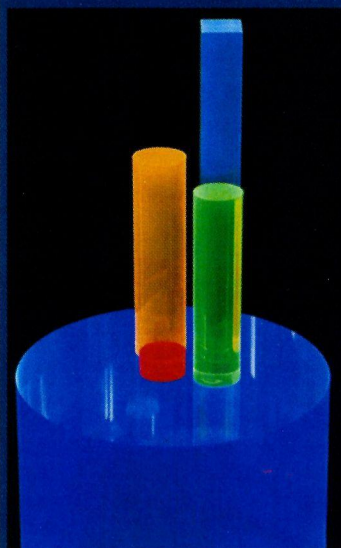


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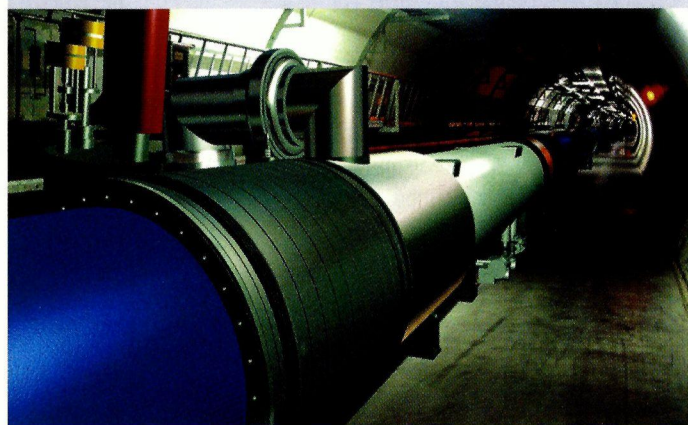
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