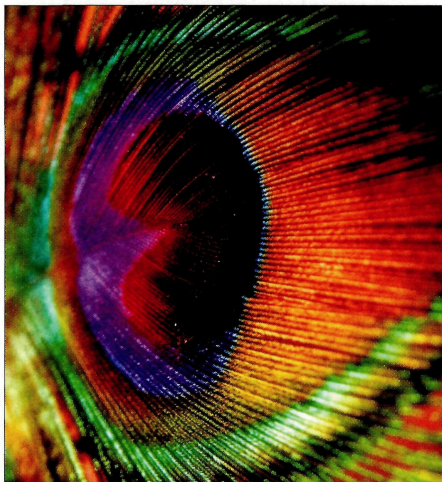


Peacock feathers prove photonic crystals cast brown light in nature

The feathers of male peacocks are among nature's most striking displays with greens, blues and other vivid colours, but mixed in there is also brown. It is already known that the bright colours arise from natural photonic crystals – structures with a bandgap that allows transmission of light only at certain frequencies. But where does the brown colour come from?

It had been thought that in the biological world brown originates in pigments, but Yizhou Li and colleagues at Fudan University in Shanghai have extended their work on peacock feathers to find that the browns also arise from photonic crystals.

The team studied the brown barbules – structures on the barbs arrayed on either side of the central stem. They found a subtly different structure for the 2D photonic-crystal



It seems that the browns in the feathers of male peacocks arise from natural photonic crystals. (Michael Shake/Dreamstime.com.)

lattice in the outer layer (cortex) for the brown barbules compared with the blue, green and yellow. Optical measurements and numerical simulations revealed that differences in the two melanin layers in the photonic-crystal structure, as well as parameters such as lattice constant and number of periods, are important in introducing reflected orange and red components.

Studies of the complex natural structures producing brown could point the way to extending artificial photonic crystals from almost single-wavelength structures to multiple wavelengths.

Further reading

Yizhou Li *et al.* 2005 Structural origin of the brown color of barbules in male peacock tail feathers *Phys. Rev. E* **72** 010902(R).

Gravity works at a distance of 100 nm

Much recent theoretical speculation implies a possible breakdown of Newton's $1/r^2$ force law at small distances. Performing a Cavendish experiment down to this sort of scale is difficult, but in 2000 Eric Adelberger and his colleagues at the University of Washington showed that gravity is as expected down to 150 μm . A collaboration between Indiana, Purdue, Lucent Technologies, Florida and Wabash has now eliminated deviations from the $1/r^2$ law owing to Yukawa-like forces down to 100 nm. There is, however, a drawback: while the experiment

reaches down to a shorter scale than has previously been achieved, it actually tests for the presence of forces 10^{12} times stronger than gravity at that scale.

The group used a disc-shaped pendulum suspended above another disc in their measurements. A copper membrane between the discs helped minimize the effects of electrical forces. Other short-range, non-gravitational effects, such as the Casimir force, also had to be considered.

Further reading

R S Decca *et al.* 2005 Constraining new forces in the Casimir regime using the isoelectronic technique *Phys. Rev. Lett.* **94** 240401.

The shape of acidity

We all learn in school that pH is a measure of the concentration of positive hydrogen ions (i.e. protons), but things look more complex than that. Traditional models were based on the notion of "hydronium" ions, H_3O^+ or $(\text{H}_2\text{O}\cdots\text{H}\cdots\text{OH}_2)^+$, but Jeffrey M Headrick of Yale University and colleagues have had a closer

look with vibrational spectroscopy. The hydrated protons are actually clusters of water molecules around a proton with up to 11 water molecules involved, making acidified water much more interesting and complicated.

Further reading

J M Headrick *et al.* 2005 Spectral signatures of hydrated proton vibrations in water clusters *Science* **308** 1765.

Ultrasound causes change in viscosity

Researchers have found a way to control remotely and reversibly a material's viscosity using sound. Takeshi Naota and Hiroshi Koori of Osaka University in Japan have created a substance from small, organic molecules containing platinum dissolved in acetone. The result is an oily liquid, which, when zapped with ultrasound at 40 kHz, turns into a white gel.

The gel can be reversed back into a liquid by heating and perhaps also in response to another burst of ultrasound. This behaviour is mysterious; as sound might be expected to cause things to liquefy rather than to gel. While there are theories about the mechanism, precisely what is going on remains a puzzle.

Further reading

Takeshi Naota and Hiroshi Koori 2005 Molecules that assemble by sound: an application to the instant gelation of stable organic fluids *J Am. Chem. Soc.* **127** 9324; DOI:10.1021/ja050809h.