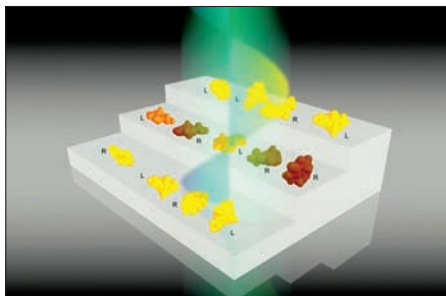


Compiled by John Swain, Northeastern University

Equations reveal a new twist on light

Despite the fact that Maxwell's equations have been around since 1865, it looks as though there is still interesting physics that can be pulled out, even at a classical level. Yiqiao Tang and Adam Cohen of Harvard University have shown that a long-ignored combination of electric field dotted with its curl, plus the corresponding magnetic quantity, can represent the degree to which a non-planar, and in a sense, highly twisted electromagnetic field can interact differently with chiral molecules of different handednesses. Waves for which this quantity is non-vanishing have complex spatial profiles and could find useful applications in chiral photochemistry and for complex interactions with nanomaterials.

Tang and Cohen have found what they call "superchiral" light with chiral asymmetries much larger than those of circularly polarized light and they have proposed an experiment that could probe such light. The idea would be to confine molecules in thin films at a range of heights above a reflective surface



An experiment designed to probe superchiral light. (Courtesy A Cohen and Y Tang/Harvard University; figure by Lu Men.)

and illuminate them with circularly polarized light to set up a superchiral standing wave (see figure). The researchers predict that molecules at the nodal planes of the standing wave will show enhanced chiral asymmetry.

Further reading

Yiqiao Tang and Adam E Cohen 2010 *Phys. Rev. Letts.* **164** 163901.

Entropy opens door to Pictish language

Physicists are not the only researchers to look for patterns in data in an effort to find underlying structure – linguists also need to find patterns, and they have had a recent hand from the concept of entropy. Rob Lee of the University of Exeter and colleagues compared symbols inscribed by the Picts – a Scottish Iron Age culture dating back to about the 4th to 9th centuries AD – with texts known to be in a written language (though not Pictish).

Measures of repetitiveness as quantified by entropy showed the inscriptions to be much closer to a modern language, with a small vocabulary, than to simple pictorial (no pun intended!) scripts. The work is particularly interesting because it could be used even when samples of whatever symbols are written are small, as is the case for known examples of Pictish. This method could also be extended to see how much linguistic content animal communications, such as those of dolphins, contain.

Further reading

Rob Lee et al. 2010 *Proceedings of the Royal Society A*. doi:10.1098/rspa.2010.0041.



Symbols from the Pictish stone 'Alberlemno 2' of the kind that Lee and colleagues have analysed.

Molecular chain makes the smallest superconductor

How few atoms or molecules does it take to make a superconductor? Amazingly, the experimental answer so far is that as few as four pairs of molecules of a rather exotic substance called $(\text{BETS})_2\text{GaCl}_4$ will do the job, where BETS is bis(ethylenedithio) tetraselenafulvalene. The substance was already known to be superconducting in bulk at about 8 K, but now Saw-Wai Hla of Ohio University in Athens and colleagues have made super-thin layers of the material by depositing molecular chains of it on a silver substrate.

They used scanning tunnelling electron microscopy to show the superconductivity down to the minute scales involved. The work is remarkable because it allows researchers to track down the mechanisms at work down to the level of only a few molecules. It could show the way to novel superconducting nanocircuits.

Further reading

K Clark et al. 2010 *Nature Nanotechnology* **5** 265.

Photonic crystals provide 3D invisibility cloak

Attempts to make Harry Potter's invisibility cloak by using metamaterials to bend light round objects have generally been restricted to two dimensions and microwave frequencies. Now, Tolga Ergin of the Karlsruhe Institute of Technology and colleagues have manufactured photonic crystals in the shape of a sort of "woodpile" that can cloak a bump in a gold reflector within a viewing angle of 60° . The cloaking works with unpolarized light from 1.4 to $2.7 \mu\text{m}$. This is fast approaching wavelengths that would be suitable for human vision.

Further reading

T Ergin et al. 2010 *Science* **328** 337.