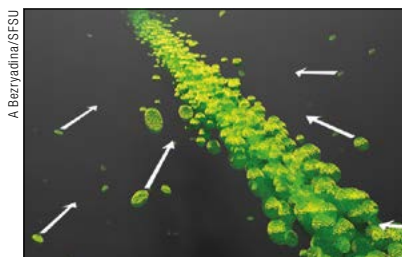


Sciencewatch

COMPILED BY JOHN SWAIN, NORTHEASTERN UNIVERSITY

Bacteria light the way

Biological media are not usually thought capable of guiding light because they do not exhibit large nonlinear optical responses, but a new study by Zhigang Chen of San Francisco State University and colleagues changes this picture. The team sent a 50 μm -wide green laser beam into a 4 cm-long tube of seawater, upon which the beam broadened to 650 μm , largely due to normal diffraction. Then a strain of cyanobacteria called *Synechococcus*, which do not move on their own and thus could not actively enter or leave the beam, were added to the tube. At low power (0.1 W) the beam



diffraction doubled, but at 3 W the beam constricted to a 0.2 mm needle – with almost all bacteria left unharmed. The data could

Bacteria are drawn inward and forward by a light beam, creating a waveguide that helps reduce the spread of the beam.

only be explained by taking into account radiation pressure, which is more important in cells with internal structures. Similar results with *E. coli* and human red blood cells suggests analogous self-focusing could provide ways to send light through normally opaque tissues for treatment or imaging.

● Further reading

A Bezryadina *et al.* 2017 *Phys. Rev. Lett.* **119** 058101.

Solar neutrinos probe Earth

Oscillations of solar neutrinos could provide valuable information on the internal structure of the Earth, according to a new study. Ara Ioannian of the Yerevan Physics Institute in Armenia and colleagues argue that the relative number of ν_e events detected during the day compared to those collected at night could be affected by the layer-like structure of Earth's density, allowing a tomographic scan of the Earth's interior. Specifically, the team studied the possibilities with the future long-baseline DUNE experiment in the US, which expects to see around 75 neutrino events per day in a 40 kt-active mass detector. Five years of data should, in addition to establishing the day–night asymmetry to a level of six standard deviations and providing valuable information on the squared mass difference between the lightest neutrinos, provide confirmation of the layer model of the Earth.

● Further reading

A Ioannian *et al.* 2017 *Phys. Rev. D* **96** 036005.

Nutmeg cooler than menthol

Menthol is a ubiquitous cooling agent used in a wide variety of products. But it turns out that nutmeg packs a punch 30 times stronger, making it the most powerful natural cooling agent known. Tomohiro Shirai and colleagues at Kao Corporation in Tochigi, Japan, identified a neolignan compound (a class of compounds that bind to a cold-sensitive ion channel in the body

Squid vision

Spherical lenses suffer from optical aberration, which prevents all rays from being focused to a single point. As long ago as 1854, James Clerk Maxwell proposed a mathematical solution to this problem by making the refractive index decrease parabolically from the centre to the edge. Although hard to implement in practice, Alison Sweeney and colleagues at the University of Pennsylvania in the US have now shown that squid already perform this trick via assemblies of transparent S-crystallin protein dimers that vary in size to achieve what Maxwell suggested. The stability of the gradient index of refraction is remarkable, suggesting an anisotropic interaction between the proteins to maintain it, and the finding suggests new ways to make aberration-free lenses.

● Further reading

J Cai *et al.* 2017 *Science* **357** 564.



A squid showing spherical gradient-index lenses that can correct optical aberration.

to trigger a cooling sensation) in nutmeg that binds at a different molecular site than menthol, suggesting that the two might be usefully combined. Used in mouthwash for a 30 second rinse, the new compound took five minutes to kick in as strongly as menthol, but then gave a cooling sensation lasting 30 minutes instead of menthol's 10 minutes.

● Further reading

T Shirai 2017 *ACS Med. Chem. Lett.* **8** 715.

Lithium battery reversed

In a conventional lithium-ion battery, ions moving inside the medium power electrons through an external circuit. In an ingenious reversal of this idea, an “electron battery” sees electrons moving internally while ions are pushed through an external circuit. Liangbing Hu of the University of Maryland in College Park and colleagues have made a prototype with a lithium-anode and vanadium-oxide cathode immersed in an organic electrolyte that stimulates the flow of calcium ions inside living cells derived from human embryonic kidney cells. Biocompatibility was achieved by using Kentucky bluegrass stems soaked in salt solution as ionic cables to connect to the cells. The drifting sodium ions then generate an electric field that releases calcium ions, demonstrating a novel electro-biomedical technology with potential applications including nerve and muscle stimulation.

● Further reading

C Wang *et al.* 2017 *Nat. Commun.* **8** 15609.



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