

Sciencewatch

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Quantum coherence for birds

Some migrating birds, such as the European robin, seem to detect the Earth's magnetic field using light-triggered chemical processes. The idea is that the absorption of a photon excites two electrons on a molecule and that one of these is then passed on to another part of the same molecule, forming a "radical pair". The pair is produced in a singlet state – but separated in space. The spin of a nucleus in the molecule can couple to one of the electrons and induce singlet-triplet mixing, which is in turn affected by the strength and orientation of an external magnetic field. Subsequent chemical reactions then distinguish between singlet and triplet states, providing information about the magnetic field.



Do birds have the edge on humans when it comes to quantum entanglement? (Image credit: Tomatito26/Dreamstime.com.)

Erik Gauger of the University of Oxford and colleagues studied this phenomenon in light of recent experimental work on the European robin species and found that superposition and entanglement of this spin system are maintained for tens of microseconds or more.

This result is far better than the best similar man-made systems can achieve and it suggests that living things, despite the usual claim that they are too "warm and wet" to maintain coherence for long, could well teach scientists some important tricks for quantum computing.

● Further reading

E M Gauger 2011 *Phys. Rev. Letts.* **106** 040503.

Stimulated Hawking radiation in the lab

Condensed-matter analogues of black or white holes (a time-reversed black hole) can be simulated in laboratory systems by the propagation of water waves in moving fluid if the local fluid-flow speed exceeds the speed of wave propagation. Silke Weinfurter of the University of British Columbia and colleagues put a streamlined obstacle into a channel of flowing water that produced a region of high flow velocity and created an effective horizon for surface waves.

They found that long-wavelength surface waves that flow upstream towards the region are converted into shorter-wavelength deep-water waves, mimicking stimulated emission by a white hole. The converted waves show a thermal distribution as expected. Because – as Albert Einstein showed long ago – stimulated emission and spontaneous emission are closely related, this is really a significant demonstration of a Hawking-like process in a laboratory system.

● Further reading

S Weinfurter *et al.* 2011 *Phys. Rev. Letts.* **106** 021302.

Relativity and the car battery

The lead-acid battery in every car has been around for more than 150 years, but it turns out that a proper understanding needs to include the effects of relativity. Rajeev

Atmospheric accelerators

Thunderstorms have long been known to produce bursts of X-rays and gamma rays, presumably from electron bremsstrahlung, but now it seems that the energies involved extend further than previously expected.

New data from the Italian Space Agency's AGILE satellite show that the high-energy spectrum reaches up to 100 MeV, with the higher energy part described by a power law without the exponential suppression with energy that is seen below around 10 MeV. It remains an open and puzzling question as to how gamma rays of such high energies are produced because present models do not provide for differences large enough to accelerate electrons to these energies, let alone for such energetic bremsstrahlung photons.

● Further reading

M Tavani *et al.* (AGILE Team) 2011 *Phys. Rev. Letts.* **106** 018501.

Ahuja of Uppsala University worked out the energies of the solid reactants in the battery (lead oxide and lead sulphate) using *ab initio* nonrelativistic calculation, as well as including the effects of relativity. The correctly calculated voltage comes out to be 2.13 V, which is in good agreement with the measured value of 2.11 V – but amazingly

1.7–1.8 V of this comes from relativistic effects (mainly involving the lead oxide).

It has long been known that relativistic effects lie at the root of explaining why mercury is liquid and why gold has the colour that it does. However, this is the first time that it has been shown to have a significant, and in this case huge, effect in a battery.

● Further reading

R Ahuja 2011 *Phys. Rev. Letts.* **106** 018301.

Grape varieties are more similar than you think

The wine grapes of various types that have been domesticated over the past 6000 years are more genetically close to each other than anyone had imagined. This is according to research by Sean Myles of Cornell, Stanford, and Acadia universities and the Nova Scotia Agricultural College, and colleagues.

Looking at more than 9000 genetic markers in the world's 583 cultivated varieties they find them all to be closely related, regardless of where they are grown. Indeed, 383 of the 583 types form a single pedigree network. It seems that crossing has occurred between a limited range of cultivars, so there remains a huge potential for new disease-resistant strains and, happily for oenophiles, types of wine not tasted before.

● Further reading

S Myles *et al.* 2011 *Proc. Natl. Acad. Sci.* published online, doi:10.1073/pnas.1009363108.