Razzle dazzle 'em

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Not content to simply lure females with their vibrant plumage, many male birds of paradise undertake complex mating rituals that resemble eccentric dances (for example, see http://go.nature.com/2a1Hyk). In the case of one species, *Lawes' parotia* (pictured; http://doi.org/bmr3tb), the reflectance spectra of the male's feathers might be tuned to the properties of the female's colour vision — the dance is then one of complex optical stimulation, as Bodo Wilts and co-workers now report.

Colouration in the feathers of the *parotia* is structural — the arrangement of melanin rodlets within the feather filaments reflects light directionally, so their hue ultimately depends on the viewing angle. The silver feathers appearing on the nape of the male's neck reflect light unidirectionally. But the more complex morphology of its colourful breast feathers gives rise to 3D reflections, and feathers that can appear alternately orange, green or blue.

Wilts *et al.* modelled the light–matter interaction for both types of feather computationally and measured scattering patterns for comparison. A convolution of the assumed spectral sensitivities of females with the measured reflectance spectra suggested that the silver feathers activated all spectral photoreceptors simultaneously, whereas the colourful feathers selectively activated different receptors depending on the angle of incident light — providing males with a temporally variable way to dazzle potential mates. *AK*

Two by two

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So far, data from the Large Hadron Collider (LHC) at CERN have revealed the existence of a Higgs boson — one that seems to line up well with the behaviour expected of a 'standard model' Higgs. Now, a full exploration of the properties of this Higgs is imperative. Although some aspects of Higgs physics fall beyond the capabilities of the LHC experiments (because, for example, their production cross-section is so small), the proton–proton collision process in which two Higgs bosons are created alongside two 'jets' of particles is one that should lend itself to useful study.

So say Matthew J. Dolan and colleagues, who have now produced a complete phenomenological analysis of this so-called *hhjj* channel. The calculations are complicated, but Dolan *et al.* have been able to get a handle on two particular contributory processes, weak boson fusion and gluon fusion — they conclude that the latter dominates. LHC measurements of *hhjj* would link to crucial details of electroweak symmetry breaking, and the prospects are, according to the authors, "challenging but not hopeless". *AW*

Electrons of a different stripe

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Earth's inner radiation belt consists of energetic electrons and protons, having energies up to hundreds of keV and beyond 100 MeV, respectively. They are trapped by the geomagnetic field at altitudes spanning roughly 1,000 km to 6,000 km. In addition, the energy distribution of the electrons across the inner radiation belt resembles the stripes of a zebra.

Such striations have been observed previously, and attributed to solar activity. However, Aleksandr Ukhorskiy and colleagues find that data taken during a six-month period, using instruments on board the Van Allen Probes spacecraft, reveal patterns that are more regular in the absence of geomagnetic storms.

Instead, the authors' simulations show that the Earth's rotation causes the stripes. It induces an electric field that affects the magnetospheric plasma within the 'co-rotation' region. As the Earth's rotation axis is offset from the magnetic dipole axis by 11°, this leads to an oscillation of the co-rotation region with respect to the outer magnetosphere. The resulting perturbation in the magnetic fields and, in particular, the induced electric fields then resonantly interacts with electrons on a diurnal cycle, creating the observed zebra stripes. *MC*

No coincidence

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How do you tell whether two photons are alike? In the Hong–Ou–Mandel quantum interference experiment, two photons enter a 50:50 beamsplitter that mixes their paths and the outcome is then measured by two detectors: if the states of the two photons are identical — that is, the photons are perfectly indistinguishable — they will always emerge together from the beamsplitter and be picked up by only one detector. The coincidence rate of the detectors then drops to zero — the signature of indistinguishability. This is a well-known effect for photons, and it turns out to hold for other quantum particles too.

James Fakonas and colleagues have performed the Hong–Ou–Mandel quantum interference experiment using plasmons, which are quantized surface plasma waves. Pairs of photons are fed into a specially designed plasmonic waveguide that mixes the paths of the light-excited surface plasmons in the same way as a beamsplitter. The outcome is converted back into photons and measured by two detectors. As in the purely photonic case, the characteristic dip in coincidence rate is there, showing that the photons remain indistinguishable when they are converted into plasmons and interfere. *IG*

Know your onions

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Many viruses have icosahedral symmetry. So do certain 'carbon onions' — Russian doll-like arrangements of nested fullerenes. Pierre-Philippe Dechant and colleagues argue that viruses and carbon onions share the same formation principle: affine symmetry.

Imagine a set of points lying on the vertices of a regular pentagon. Duplicate the set, and translate it; then repeatedly rotate the combined set over 72° about the midpoint of the original pentagon. This results in a new set of points obeying five-fold symmetry, yet with a 2D shell structure that is more complex than that of the pentagon. A similar 'affinization' of the (3D) icosahedral group results in a set of points that are nodes in the highly complex protein network structure of, for example, the Pariacoto virus.

Dechant *et al.* found that affine symmetry explains the structure of experimentally observed carbon onions — a non-trivial result given that all carbon atoms in each of the nested fullerene molecules must be three-connected, that is, bound to three neighbouring carbons. In particular, they identified the extended group that, starting from buckminsterfullerene (the 'buckyball'), generates the onion $C_{60}@C_{240}@C_{540}$. *BV*

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