Pimp my filament

Nano Lett. http://dx.doi.org/10.1021/nl2022042 (2011)

Resolving the minutiae of the fibres driving cell migration is no easy task — particularly when it involves keeping the cells alive. Even the best attempts at nanoscale resolution of the three-dimensional structure of intracellular filaments have fallen short of the task of *in vivo* measurement in real time. Laura Estrada and Enrico Gratton have met this challenge by demonstrating that their technique, dubbed gold enhancement nanoimaging, enables highly reproducible imaging of filaments inside a living Chinese-hamster ovary cell.

The method involves decorating each filament with gold nanoparticles that adsorb to the surface of the fibre. Irradiation of the particles with near-infrared femtosecond pulses induces a photoacoustic effect, which incites a rapid expansion of the surrounding medium, producing a pressure wave, which propels the nanoparticles along the fibre. By simultaneously tracking the nanoparticles, Estrada and Gratton obtained a clear map of filaments inside the cells. The beauty of the approach lies with the simple fact that as the nanoparticles are electrostatically attached to the fibre, propulsion can only occur along the fibre — guaranteeing that the trajectory faithfully maps the surface of the filament. *AK*

A fictitious marriage?

Phys. Rev. Lett. (in the press); preprint at http://arxiv.org/abs/1106.3224

Quantum mechanics permits stronger correlations between remote measurements than are allowed classically. A routine procedure to test whether a pair of particles is engaged in such a non-classical liaison is through the violation of a 'Bell inequality'. The procedure reveals the presence of quantum correlations independent of the physical device used based on purely statistical criteria, and therefore in an unambiguous manner.

Or does it? A note of caution comes from Ilja Gerhardt and colleagues, who have demonstrated that in a typical experimental setting the violation of Bell's inequalities can be faked using purely classical light. Their 'faked-state generators' can cause avalanche photon detectors — standard components in such experiments — to produce any desired measurement outcome by sending bright light pulses instead of single photons.

Even when the legitimate users have full knowledge of their measurement devices and observe no unusual behaviour, an adversary can fool them into seeing quantum correlations where there are none. Similar to the conclusion reached in related work (*New J. Phys.* **13,** 063031; 2011), Gerhardt *et al.* warn that the assumptions underlying Bell tests, in particular regarding to the so-called detection loophole, have to be meticulously observed. *AT*

A stronger single photon

Phys. Rev. Lett. **107,** 133603 (2011)

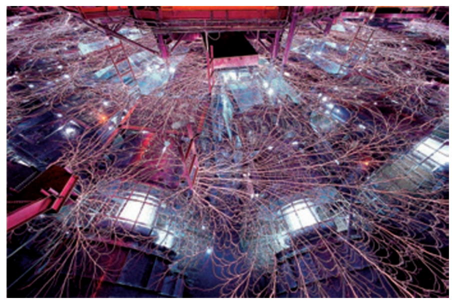
How do you amplify a single photon? By making it act like many photons. Amir Feizpour and colleagues have now shown how this might be possible using so-called weak measurements.

Boosting a conventional signal to improve the ratio of signal to noise is a crucial element of any computation or communication system. In photonic systems, this is often achieved using a material with nonlinear optical properties. But at the single-photon level, these effects are tiny. Feizpour *et al.* now propose that 'weakly' probing a photon in the nonlinear medium with a second optical beam can amplify the effect.

Weak measurements can interrogate a quantum state without disturbing it. It requires a process of post-selection in which only photons with a specific property are retained. The authors show that the improvement in the signal-to-noise ratio using their technique outweighs the loss of photons during post-selection. This idea could have a role in the development of optical quantum logic gates. *DG*

Plasma guns feel the pinch

Phys. Plasmas **18,** 092707 (2011)



SANDIA NATIONAL LABORATORIES

Among the earliest devices developed to try to harness thermonuclear fusion is the Z-pinch (such as the Z machine, pictured, at Sandia National Laboratories). These devices operate by feeding an electrical current of up to several tens of millions of amperes into a space of just a centimetre or less. They get their name from the fact that the Lorentz force on such extreme currents pinches them inwards to produce plasmas of extreme energy density.

One of the practical problems faced by these devices is that the array of thin tungsten wires needed to seed the plasma at the heart of a Z-pinch must be replaced every time it is fired. This severely limits the repetition rate at which they can be operated. A. G. Rousskikh and colleagues instead use vacuum arc plasma guns to produce an annular cylindrical plasma. Although they operated their device at a relatively modest current of 450 kA through the plasma, the resulting pinch reached a temperature of around four million kelvin — a promising start but still short of the hundreds of million kelvin required to initiate fusion. *EG*

It's a mystery

Phys. Rev. D **84,** 071301 (2011)

As the particle physics community struggles to understand the OPERA experiment's seeming detection of superluminal neutrinos, anomalous results from other neutrino experiments are also under scrutiny. The LSND experiment, which ran at Los Alamos National Laboratory in the 1990s, found evidence of neutrino oscillations that didn't tally with the standard model of three neutrino species, or with other experimental data. And MiniBooNE, at Fermilab, has seen excess events that could support a particular explanation of the LSND anomaly — that there is an additional heavy neutrino (or even more than one), which is some kind of admixture of the usual three neutrino species but 'sterile'.

Many authors have considered where definitive evidence of the sterile neutrino might be found. Assuming, unusually, that the sterile neutrino might have a dominant radiative decay mode, Claudio Dib and colleagues investigate the possibilities of kaon decay (to a muon, a neutrino and a photon) and tau-lepton decay (to a muon, two neutrinos and a photon). Existing data on these processes are, they point out, not conclusive, limited by the experimental precision. But the authors suggest that kaon decay to four leptons (muon, neutrino and two electrons) could hold a useful clue — if experiments could push to be sensitive to low enough invariant masses of the electron pair. *AW*

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