No flash in the pan

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The single bright radio burst of 2007, known as the 'Lorimer Burst', caused a sensation as it was reported to be of extragalactic origin. It remains somewhat mysterious, although now its source is suspected to be terrestrial rather than celestial.

However, while using the Parkes 64-m radio telescope in Australia to scan the sky for pulsars and other pulsed radio sources, Dan Thornton and collaborators have detected four transient millisecond radio bursts that really do seem to have come from cosmological distances — up to 8 billion light years in one case. Moreover, they are more luminous than any known transient radio sources. Follow-up scans have detected nothing, suggesting that these new bursts hail from cataclysmic events such as galaxy mergers, explosions from supermassive black holes or magnetars, or possibly some as yet unknown source.

Given their transient nature, detection of fast radio bursts relies on looking in the right direction at the right time. The authors extrapolate that, across the entire sky, there should be 10^4 such bursts per day. To study them, large surveys using arrays of time-domain telescopes will be needed. *MC*

Live long

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What, wonders Julian Heeck, is the lifetime of the photon? It's not an outlandish question: adding a photon mass term to the Lagrangian of quantum electrodynamics would, admittedly, break gauge invariance and ruin renormalizability, but it's possible to write a gauge-fixed version of the Lagrangian by invoking the Stückelberg mechanism and allowing a photon mass. A photon whose mass is not zero could decay, possibly into neutrinos or particles hypothesized in extensions of the standard model, such as axions.

However, Heeck has for the moment ignored the decay products in favour of setting a model-independent limit on the lifetime of the photon — and does so using an existing set of data on the oldest photons in the visible Universe: measurements of the cosmic microwave background made by NASA's Cosmic Background Explorer. Assuming the photons to be free-streaming (effects of primordial plasma will be built into future work), Heeck sets a lower limit of about 3 years on the photon lifetime in its rest-frame, which corresponds to a lifetime of 10^{18} years for photons in the visible spectrum. *AW*

In the shadow of the Sun

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Magnetic-field lines around a bar magnet are easily imaged using iron filings and a piece of paper. However, applying such a technique to the Sun is not so simple, unfortunately, as knowledge of its field could help predict changes in solar wind that affect our planet. The Tibet ASγ Collaboration now shows that a 'shadow' cast on the Earth by the Sun is a sensitive probe of this complex magnetic structure.

Cosmic rays travel to Earth from outside the Solar System. The Sun blocks some of them, creating a cosmic-ray shadow. The researchers analysed data taken from the Tibet Air Shower Array — a γ-ray detector high in the foothills of the Himalayas — to monitor how the intensity of this shadow varied between 1996 and 2009: the shadow is darker when solar activity is at a minimum, they found.

Comparing these data with the predictions of two different theoretical models of the magnetic field in the solar corona, it seems the results support a model that incorporates the influence of electric currents flowing through the corona. *DG*

Atomic quiver

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Zitterbewegung — the fast trembling motion of relativistic quantum particles — was predicted by Erwin Schrödinger as a direct consequence of the Dirac equation. But there was little hope of observing the *Zitterbewegung* of a free relativistic particle due to its high oscillation frequency (of the order of 10^{21} Hz) and amplitude close to the Compton wavelength. The quiver has been spotted in analogue situations instead: for example, the fast oscillations of quantities equivalent to the position of the particle have been tracked in experiments using trapped ions and photonic lattices.

Now Lindsay LeBlanc and colleagues have observed the *Zitterbewegung* of atoms directly in a Bose–Einstein condensate. The atoms in the condensate interact with two counter-propagating laser beams that couple the hyperfine states with the atomic motion. The atoms essentially behave like relativistic particles obeying the one-dimensional Dirac equation. Direct imaging of the condensate yields position and velocity data, clearly showing micrometre-amplitude oscillations with a frequency of a few kHz — the atomic *Zitterbewegung*, whose origin can be understood by analogy with Rabi oscillations. *IG*

Graphene smoothed out

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An energetically stable graphene bilayer can be realized in only one way: the 'AB' stack, in which the two layers are shifted with respect to each other. If a third graphene sheet is added, it can be positioned above the first layer (the ABA stack); or shifted again (to produce an ABC stack). Although the former is slightly more stable, domains of both stacking types occur in samples of trilayer graphene.

Wenjing Zhang and colleagues have now discovered a trick that can induce the transformation of ABC-stacked into ABA-stacked domains. It involves triazine molecules, which have the structure of benzene but with three of the carbon–hydrogen units replaced by nitrogen atoms. Simply evaporating triazine molecules onto a graphene trilayer at 150 °C for 8 hours effects the ABC–ABA change.

Zhang *et al.* calculated and compared the formation energies of different kinds of ABA–ABC domain boundaries. They found that the likeliest scenario is that the top graphene layer has a 'wrinkle': on one side of the wrinkle the structure is ABA-stacked; on the other, ABC-stacked. Molecular dynamics simulations show that the adsorbed triazine molecules effectively 'iron out' the wrinkle, driving it away from the domain boundary and resulting in an ABA-stacked structure. *BV*

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