Dynamical breaking

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So far, the Large Hadron Collider (LHC) has come up with no evidence for supersymmetry (SUSY) — and SUSY is running out of places to hide. SUSY implies that for every particle in the standard model, there exists a partner 'superparticle'. Although the so-called minimal supersymmetric standard model is now severely constrained, there are other ways to include SUSY in our particle theories: Csaba Csáki and colleagues suggest factoring in 'dynamical R-parity violation'.

R-parity violation (RPV) — allowing superparticles to decay to particles — has often been considered in SUSY scenarios; however, the lack of experimental proof means that RPV must be highly suppressed. But Csáki *et al.* postulate a more nuanced implementation, with RPV broken dynamically (in a 'hidden' sector) and also related to the breaking of SUSY itself.

Consequences include some interesting experimental signatures, although these depend on which superparticle is the lightest one: if the stop (the partner of the top quark) is the lightest, the signal would be two pairs of bottom quarks, with the vertex of each pair's trajectories displaced from the LHC interaction point; or if it's a sneutrino (a neutrino partner), four displaced top quarks should be sought instead. *AW*

Easy as pi

Nature **508,** 369–372 (2014)

The resistance-free transport offered by superconductors is not so easily exploited by alternating currents. Radio waves can induce quasiparticle excitations, above the superconducting gap, which open dissipation channels. Incorporating these quasiparticles in a description of the tunnelling current across a Josephson junction still generates controversy despite the success of Josephson's theoretical predictions.

Ioan Pop and colleagues have now shown that controlling the phase across a Josephson junction allows the losses caused by quasiparticles to be suppressed. This idea, which effectively uses electron-like and hole-like quasiparticles to cancel each other out, confirms one of Josephson's original predictions. By introducing a π phase difference across a junction, Pop *et al.* showed that this cancelling technique increased the relaxation time of their superconductor-based qubit by more than an order of magnitude.

This method not only has technological implications, extending beyond quantum information processing, but also provides a powerful tool for characterizing the quasiparticle-induced dissipation mechanism in Josephson junctions. *LF*

Motion picture

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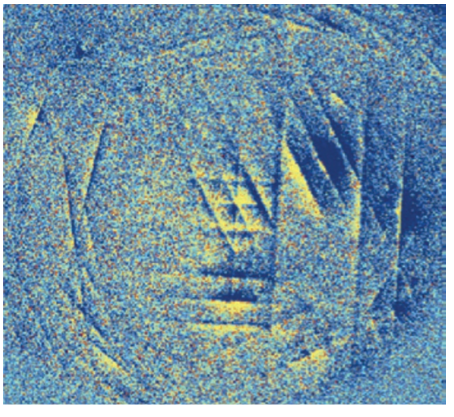

A transmission electron microscope is usually thought of as a tool for investigating a material's crystal structure, not for probing its elastic properties. However, a series of electron-microscopy images, recorded sufficiently rapidly one after another, should provide information on structural dynamics.

Wenxi Liang and colleagues have done exactly that, using a method called convergent-beam electron diffraction (CBED). Whereas most electron-microscopy techniques require thin samples so that electrons travelling through the sample scatter only once, CBED works well with thicker samples. The diffraction pattern then contains lines, known as Kikuchi lines, resulting from many electrons being incoherently scattered.

The team applied femtosecond laser pulses, used to excite lattice vibrations, to a graphite sample and recorded the time evolution of the Kikuchi lines. They collected data spanning a total time interval of 1 millisecond. The results (involving Fourier transforms of Kikuchi line evolutions, as pictured) revealed strong vibrational features at 9.1 and 75.5 GHz, attributed to motion of the graphene planes along the stacking direction and an in-plane 'breather' mode, respectively. *BV*

Up against the wall

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For bacteria, maintaining the structural integrity of the cell wall is essential for survival. Human cells have membranes instead of walls, so disrupting cell-wall synthesis is a neat way of targeting bacterial infection. Now, Ariel Amir and co-workers have found that cell-wall growth influences how bacterial cells deform in response to external stress.

Amir *et al.* grew *Escherichia coli* and *Bacillus subtilis* cells in microchannels and suppressed their division so that they continued to elongate. The team then subjected them to hydrodynamic forces and showed that the cells behaved like elastic rods under transient (pulse-like) forces, but deformed plastically when subjected to longer lasting forces. In both cases, the cells recovered their native shape, although the plastically deformed cells only did so following substantial cell-wall synthesis.

Based on their keen observation that previously reported plastic deformations involved constraining cells for longer than their mass-doubling time, the authors hypothesized that deformations were plastic only when the wall had adequate time to grow under force. Their theoretical framework confirmed what their experiments demonstrated: when force was applied for long enough, coupling between mechanical stress and wall synthesis caused the differential growth that resulted in plastic deformation. *AK*

Stellar flashback

Astrophys. J **785,** 146 (2014)

Final flash stars are so rare that only three active ones are currently known, including Sakurai's Object in Sagittarius. They are white dwarf stars with sufficient hydrogen and helium to reignite the core in a final burst of helium shell burning. Kenneth Hinkle and Richard Joyce are using the Gemini Observatory on Mauna Kea to track the rapid evolution of Sakurai's Object.

First observed in 1996 by amateur astronomer Yukio Sakurai, it just happened to be undergoing a final flash that had started two years earlier — brightening by a factor of 10,000 before cooling down to a carbon star. As the final flash also threw out dust, Sakurai's Object has been optically obscured since 1999. The debris cloud, bipolar in structure, is starting to allow infrared radiation to escape.

Hinkle and Joyce are able to resolve Sakurai's Object in addition to fainter stars. By comparing images taken in 2010 and 2013, they show that two lobes of gas are moving outwards from the central star, whose planetary nebula is also bipolar. A single source would be more symmetric, suggesting the presence of a companion star or planet. *MC*

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