QUANTUM DYNAMICS

A new spin on lensing

Phys. Rev. X (in the press); preprint at http://arxiv.org/abs/1704.08837

A basic operation in quantum networks is to transform photonic, 'flying' qubits into stationary qubits in a matter system. One way to make the mapping efficient is to use large ensembles of atoms. These absorb photons with high probability and store the quantum information they carry in collective spin excitations. The information, however, ends up encoded in delocalized states, which precludes the sort of local manipulation needed for processing it further. Help may now come from Alexander Glaetzle and colleagues, who have proposed an elegant solution for converting delocalized matter qubits into localized ones.

They argue that the Hamiltonian of atomic arrays can be changed — for example, through suitable laser fields applied to an ensemble of Rydberg atoms — to allow it to act as a 'quantum spin lens'. Delocalized states are then coherently focused, ultimately to single atoms, in a process analogous to how optical lenses work. Glaetzle *et al.* present several variants of their lenses, including multifocal ones, where a single delocalized spin excitation is transformed into a state with entanglement between excitations at spatially separated focal points. *AHT*

COSMOLOGY

A changing constant?

Nat. Astron. **1,** 0216 (2017)

The idea that most of our Universe consists of unknown forms of matter and energy is disturbing. But with observational evidence gathering — notably the Dark Energy Survey data release last month — this uncomfortable scenario is becoming more convincing. Dark matter and dark energy can be incorporated in the current cosmological working model, the lambda cold dark matter (ΛCDM) model. The accelerated expansion of the Universe, driven by dark energy, is accounted for by the cosmological constant Λ. But this is not hassle free: there are discrepancies between the parameters of ΛCDM derived from the cosmic microwave background and other cosmological measurements.

Gong-Bo Zhao and colleagues have suggested a way to relieve these tensions: consider a dynamical dark energy model in which Λ is a function of the redshift. Using statistical tests, they analysed the tensions between datasets from different sources and found that that dynamical dark energy is slightly favoured over ΛCDM. It is, of course, too early to draw any definitive conclusions, but upcoming observations will hopefully settle the nature of the cosmological constant. *IG*

ULTRACOLD GASES

Reveal the unseen

Science **357,** 484–487 (2017)

Interacting electrons in some materials can be 'fractionized' into independent particles carrying spin and charge, respectively — an unusual behaviour known as spin–charge separation. Doped holes can then move freely in the system, changing the charge distribution while leaving the magnetic order unaffected. Timon Hilker and colleagues have now shown that, in hole-doped ultracold Fermi–Hubbard chains, this phenomenon can be seen directly.

In solid-state systems, experimental determination of this quasi-long-range order is far from easy, as the oft-used two-point spin correlation functions are sensitive to the presence of holes, making the order rather hidden. Hilker and co-workers solved this problem by using a fermionic quantum gas microscope, which allows full access to the spin and density distributions in the system with single-site resolution. A string correlation function was constructed to reveal the hidden antiferromagnetic order in the ground state. These results provide a microscopic picture of spin–charge separation independent of the more frequently discussed spectral properties or excitation dynamics. *YL*

THEORETICAL ECOLOGY

Sea fairies

Sci. Adv. **3,** e1603262 (2017)

MARTIN HARVEY / ALAMY STOCK PHOTO

Ecosystems are beautiful manifestations of the tension between the individual species and emerging collective phenomena. For example, in semi-arid grasslands it is possible to run into sudden isolated circles of barren terrain — these are called fairy circles (pictured), a fitting name for a seemingly inexplicable feature, which can be understood only in the context of collective competition.

Now, Daniel Ruiz-Reynés and colleagues have revealed that one needn't travel far to find fairy circles, as they appear underwater all around the Mediterranean Sea. Focusing on *P. oceanica* and *C. nodosa*, the researchers used microscopic parameters for growth and death of shoots, apices and rhizome to construct a coarse-grained model for whole meadows. Incorporating nonlinearities to capture saturation effects, and spatial interactions for the description of facilitative and competitive interactions, their model reproduces diverse and complex self-organized vegetation patterns. For intermediate values of growth and death rates, solutions to their model exhibit stripes, dotted or leopard-print patterns, hysteresis and dissipative solitons — all spotted somewhere in the Mediterranean.

Complex dynamical models of plant growth may enable us to infer ecosystem stability and mortality rates from the observed meadow patterns. *FL*

BIOPHYSICS

Not hairy enough

eLife **6,** e25078 (2017)

Distinguishing left from right seems like something we figure out long after we've mastered other, more important tasks — such as talking and walking. But our cells establish the difference early in development. The left–right axis of most vertebrates is set up with the help of flows created by cilia, tiny hair-like structures that coat the inside of our cells. Debate is ongoing as to whether the sensing mechanism cells use to detect flow asymmetry is chemical or mechanical in nature. And now, Rita Ferreira and colleagues have shown that flow detection can't occur via mechanosensing — at least not in the way we'd previously thought.

One hypothesis holds that the flow creates a chemical gradient, which in turn establishes the asymmetry. Another model implicates a type of sensory cilium that is able, in principle, to detect the flow mechanically. But the calculation performed by Ferreira *et al.* — including parameters from *in vivo* experiments on zebrafish — suggests that there simply aren't enough of these cilia to elicit such a response. This doesn't mean that mechanosensing is not at play, but it certainly widens the search for the culprit. *AK*

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