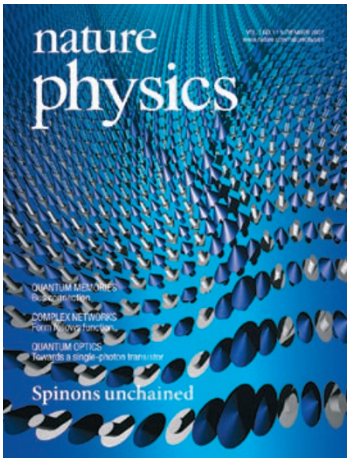

Cover story

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Although excitations with fractional charge were observed in the quantum Hall effect more than twenty years ago, fractional quantum numbers are strange beasts still, and the search for their spin counterpart has proved more difficult. In compounds composed of one-dimensional spin chains, spin and charge degrees of freedom can decouple and move independently as ‘spinons’ and ‘holons’. The concept is more difficult in two-dimensional theories — how can spinons move out of the chains? Masanori Kohno, Oleg Starykh and Leon Balents provide a plausible answer: spinons couple up and form a ‘triplon’. As an entity with integer quantum number, a triplon can escape the shackles of the chain gang and move in two dimensions. Moreover, the authors argue that triplons have been revealed by neutron-scattering experiments in a frustrated quantum antiferromagnet.
[Article p790; News & Views p756]

SINGLE-PHOTON TRANSISTOR

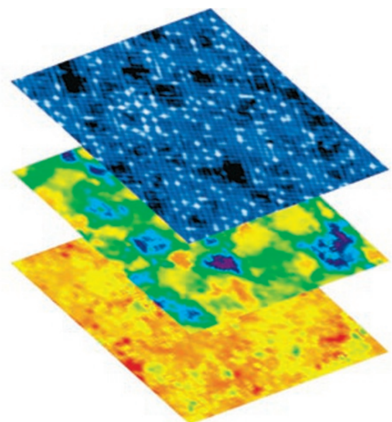
It has long been suggested that all-optical analogues of the diodes, transistors and logic gates of today’s silicon chips might one day replace them in tomorrow’s computers. The problem with using light rather than electrons to process information, however, is that photons rarely interact. To overcome this, Darrick Chang and colleagues propose coupling two optical signals via the plasmonic modes of a metal nanowire. Exciting a single optical emitter near the nanowire switches on the nanowire’s ability to transmit surface plasmon polaritons, which could, in turn, control the passage of light through a nearby waveguide. The result would be a single-photon transistor — a significant milestone in the development of quantum optics.
[Article p807; News & Views p755]

COHERENT COUPLING

A central task in quantum information processing is the storage of quantum states, and their faithful transfer between different parts of a physical system. One platform for such experiments are ensembles of atoms that can store a quantum state in the form of a quantized collective spin excitation, which can be efficiently mapped onto a photon. Jonathan Simon and colleagues entangle two atomic ensembles by phase-coherent transfer of a single spin-wave quantum via an optical bus. The experiment is the first demonstration of entanglement between macroscopic systems through direct interaction, rather than projective measurement.
[Letter p765]

GAPS IN OUR KNOWLEDGE

High-temperature superconductors differ from classic superconductors in that they do not evolve from a normal metallic state. Some believe that the superconducting state evolves smoothly from a ‘pseudogap’ state, in which the electrons are paired but lack the phase coherence of a superconducting state. Others believe that the pseudogap state is a competing state. Two papers in this issue provide experimental evidence for the competing-state view. Vladimir Hinkov and co-workers use inelastic neutron scattering to show that the spin excitations in the two states are qualitatively different. Michael Boyer and colleagues use scanning tunnelling microscopy to resolve two gaps that have different temperature dependencies.
[Letter p780; Article p802]



Gap map: evidence in favour of the two-gap picture in a bismuth-based cuprate.

p802

COMPLEX INTERPLAY

A large number of complex systems around us — from the World Wide Web to food webs — can be studied in the framework of complex networks. Many of these real-world structures, however, evolve over time. The effect of the network’s topology on its dynamics is clear, but the question of how dynamics influences the topology has so far received less attention. Diego Garlaschelli and co-workers set up and analyse a prototype model for studying the interplay between topology and dynamics, and find that their system self-organizes to a state that differs from that obtained when the two processes are considered separately.
[Article p813]

ANYON OUT THERE?

Exotic quasiparticles known as anyons fascinate theoreticians because of their unique properties and potential use in quantum computing. For the experimental study of anyons, strongly interacting systems — such as the fractional quantum Hall fluids — are prime candidates. These systems, however, tend to be fragile, making the manipulation of anyons particularly challenging. Conan Weeks and colleagues propose a different ‘home’ for anyons — a weakly interacting solid-state heterostructure consisting of a superconducting film and a semiconductor hosting a two-dimensional electron gas. This system could provide a more robust environment for their generation and manipulation.
[Article p796; News & Views p763]

IN A SPIN

The read-out and manipulation of single spins, as well as decoupling them efficiently from their environment, are important aspects of most spin-based quantum information proposals. Static detection of single electrons confined in semiconductor quantum dots has already been demonstrated, but Maiken Mikkelsen and colleagues take a step further and measure the coherent dynamics of single electron spins, with nanosecond temporal resolution. Their all-optical dynamical approach enables measurement of electron spin decoherence and the electron *g*-factor, and also provides information about the local environment in which the electrons reside, with a sensitivity better than 100 nuclear moments.
[Letter p770]