How to relax
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Well-isolated and pure, quantum gases offer a promising test bed for investigating how closed quantum systems relax to equilibrium — a fundamental problem in many-body physics. The effect of spin on the relaxation of bosonic quantum gases has previously been explored, but Ulrich Ebling and colleagues now elucidate the relaxation processes when Pauling blocking is added to the mix.

Starting with just two of the ten available spin states occupied, Ebling *et al.* observed the relaxation of a large-spin fermionic gas of potassium atoms. With spin and spatial degrees of freedom both involved, complex dynamics drive a redistribution among all spin states. Indeed, several different collision processes that cause spin changes, occurring on different timescales, were observed by the authors.

Although collision-assisted spin redistribution was the slowest process in the system, changes in the gas density could alter the relaxation rate by orders of magnitude. Ebling *et al.* also showed that the relaxation dynamics could be further controlled by tuning an applied magnetic field. *LF*

Stacks of entanglement
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Putting the power of quantum entanglement at our disposal is the stuff of quantum theorists' dreams. More often than not, however, reality doesn't look quite as elegant as the mathematics — decoherence is largely to blame.

One clever theoretical solution to the problem of constructing more robust quantum states relies on concatenating layers of entanglement — using smaller states as building blocks for larger ones. Now, it's no longer just theory: He Lu and colleagues have demonstrated the creation of concatenated Greenberger–Horne–Zeilinger (GHZ) multi-partite entangled states using many photons.

In their experimental set-up, the team encoded logical qubits in polarization Bell states of photon pairs. In this way, six photons were used to create a three-qubit GHZ state, whose robustness against decoherence was reinforced by the underlying additional bi-partite entanglement layer. The fragile multi-partite quantum correlations thereby lasted measurably longer than those established in any other system thus far. *FL*

Runaway star
Astron. & Astrophys. **565,** A90 (2014)

Magnetars are an extreme type of neutron star, having the strongest magnetic fields in the Universe — up to 10^{11} tesla. In particular, the magnetar in the Westerlund 1 star cluster of the Milky Way is a remnant of a progenitor that might have been forty times more massive than the Sun. So, why did it not collapse into a black hole following the supernova?

Simon Clark and colleagues believe the magnetar was part of a binary system, and they have found the companion star: Westerlund 1-5, a runaway star with an unusual chemical composition. This was the more massive star, but it transferred its outer layers to the magnetar progenitor as it ran out of fuel, causing the progenitor to rotate faster.

The spin-up process could be a crucial factor in creating such powerful magnetic fields. At some point, the progenitor became so massive that it started to shed mass, some of which was transferred back to the companion, thus explaining its composition. Having lost that mass, the progenitor avoided becoming a black hole. *MC*

Sense for symmetry
Nature Commun. **5,** 3735 (2014)

Our body's natural sensors are adept at distinguishing chiral molecules, but artificial systems still fall short on this count, particularly when the molecules in question are in a vapour phase. Man-made sensors for environmental and pharmaceutical applications would clearly benefit from the sophisticated chiral discrimination boasted by our olfactory perception machinery. And now, Takuya Ohzono and co-workers have succeeded in realizing an effective chiral sensor.

Some nematic liquid crystals exhibit detectable changes in alignment in the presence of chiral molecules, but when dissolved in gas, the molecules are so small that the change is difficult to make out. The problem is compounded by the fact that the liquid crystals in existing chiral sensors are generally bounded by a solid or liquid interface, which affects the way that the molecules are incorporated.

The chiral sensor devised by Ohzono *et al.* exploits a structural change in the periodic microstructure of a nematic liquid crystal, confined in a microchannel in such a way as to enhance the change. Their set-up also allows rapid dissolution of the vapour molecules, making for a simple, fast and highly sensitive process, operable at ambient temperature and pressure. *AK*

Feel the heat
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Ferromagnetic materials produce heat when exposed to a high-frequency alternating magnetic field — a consequence of their intrinsic hysteresis loop. Such 'magnetic heating' could be exploited in hyperthermia therapy for cancer treatment at the single-cell level: a magnetic nanoparticle could act as a 'heater' for a nearby target cell.

Detailed understanding of the local-heating process near a ferromagnetic nanoparticle is essential for any such biomedical application, and Juyao Dong and Jeffrey Zink have taken an important step forward by synthesizing dual-core nanoparticles, containing both a heater and a thermometer, and performing a comprehensive study of the particles' heat production.

The authors embedded mesoporous silica nanoparticles with iron-based nanocrystals (Fe_3O_4) and nanorods of a particular up-conversion compound ($NaYF_4$:Yb^{3+}, Er^{3+}). The latter's up-conversion emission spectrum has two luminescence bands and the intensity ratio of the bands is temperature-dependent — a feature that provides a temperature probe. By monitoring the temperature evolution under various experimental conditions, Dong and Zink found that the temperature increase is proportional to the field induction power and linearly dependant on exposure time, and that it takes a few seconds to cool back down to ambient temperature. *BV*

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