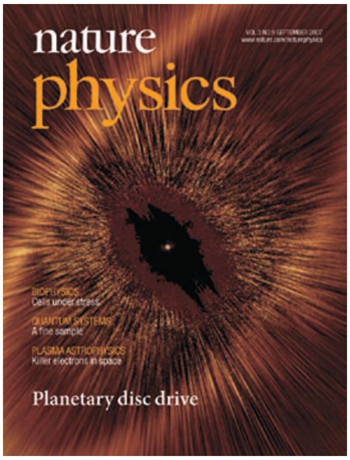


Cover story

Vol.3 No.9 September 2007

The final stages of planet formation take place within a disc of dust and gas surrounding a young star. Part of the disc spirals inwards onto the central star, dragging along the fledgling planets and setting their final orbits, but what drives this gas flow is still unclear. Eugene Chiang and Ruth Murray–Clay study the recently discovered 'transitional' discs, in which the innermost regions around a star are swept clean of dust. They propose that the dust-free condition enables a coupling between disc magnetic fields and rotating gas, owing to the ionization of the gas in the inner disc by X-rays emitted from the star. The ionized gas then activates a magnetic instability at the rim, which drives gas towards the central star while radiation pressure from the star pushes out any dust accompanying the infalling gas. **[Letter p604]**

QUANTUM STRAW POLL

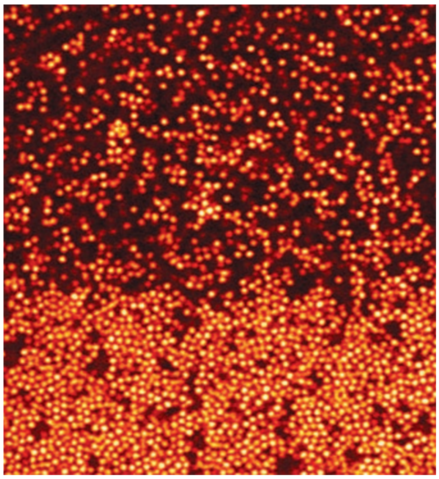
A small sample drawn from a box containing a large number of white and black balls provides a good estimate for the overall ratio of white to black balls in the box. Renato Renner shows that the same is true if the classical balls are replaced by quantum particles. He proves that knowing a large quantum system is symmetric suffices to predict its physical properties from the observation of only a limited number of subsystems — a result that provides general insight into fundamental issues regarding the interpretation of experimental data, but that can also be used to solve current problems in quantum cryptography. **[Article p645]**

COPING WITH STRESS

Biological cells move in mysterious ways. Cells adhere to their surrounding matrix, whether tissue or culture, and move by breaking then reattaching their adhesion sites. Their orientation, then, is affected by their environment as well as by any external force that may be applied. Rumi De and colleagues present a model — in which the cell is envisaged as a contractile force dipole — that captures this behaviour and explains why a cell orients itself differently, as is observed, when subject to applied stresses of varying frequency.
[Article p655; News & Views p592]

ACROSS LENGTH SCALES

Around the critical point, the physical properties of many systems obey simple, universal scaling relations. Patrick Royall and colleagues present evidence that — at least in certain phase transitions — critical scaling can also be applied far away from the critical point. They have studied a phase transition in colloid–polymer mixtures, a system in which they have access to both the macro- and microscopic length scales, which are relevant in describing the system close to and far away from the critical point, respectively. Their findings suggest that the behaviour of the system on both length scales can be described in a single framework.
[Letter p636; News & Views p594]



The interface between two phases visualized at the single-particle level.

p636

VERDICT ON KILLER ELECTRONS

Between 19 October and 7 November 2003, a violent solar storm hit the Earth's magnetosphere. The interaction of this storm with the outer Van Allen belt resulted in the generation of an intense flux of relativistic electrons that caused dozens of satellites to malfunction, one being knocked out completely. Such events are not unexpected, but the precise mechanism by which the so-called 'killer electrons' are accelerated to energies of many MeV has long been a subject of debate. Yue Chen and colleagues present data from multiple satellites at several different altitudes in the vicinity of the outer Van Allen belt. Their results indicate that resonant wave–particle interactions are the dominant mechanism for the acceleration of electrons to relativistic speeds.
[Letter p614; News & Views p590]

OPTICAL SIMILITUDE

Self-similarity occurs in many physical contexts, from the fractal nature of coastlines to the statistics of internet traffic, but is rarely associated with optics. Recently, however, it was found that, under appropriate conditions, an arbitrarily shaped optical pulse injected into an optical-fibre amplifier can evolve into one whose shape varies in a self-similar manner. The resulting pulses — known as 'optical similaritons' — arise from the interaction of dispersion, nonlinearity and gain. They are in many respects similar to that more common nonlinear entity, the soliton, but are much more stable at high power. John Dudley and colleagues review the characteristics and potential applications of similaritons and self-similarity in high-power, high-speed optics.
[Review Article p597]

SPLIT PERSONALITY

Heavy-fermion superconductors are host to many-body effects and strong electron–electron correlations that lead to strange behaviour. For instance, the *f*-electrons behave in a localized manner in some measurements and are itinerant in others. To gain insight into the microscopic origin of this dual character, Shin-Ichi Fujimori and co-workers measured the electronic band structure of UPd_2Al_3. They found that above a given temperature, the 5*f* electron states lie well below the Fermi energy, so they are localized. But for lower temperatures, the 5*f* states move to the Fermi level so that the 'heavy' electrons can go with the flow.
[Letter p618]