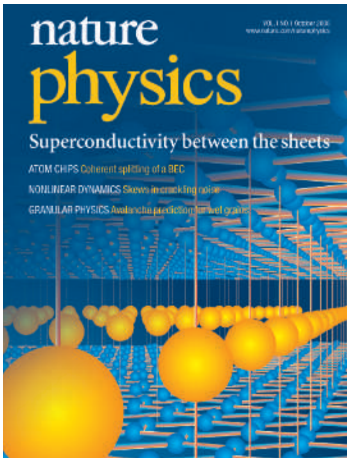

COVER STORY

Vol.1 No.1 October 2005

Graphite was first known as 'black lead', and the resemblance doesn't stop there — both lead and graphite are superconductors. Thomas Weller and co-authors have intercalated ytterbium or calcium atoms between graphene sheets and discovered superconductivity in C_6Yb and C_6Ca below 6.5 K and 11.5 K, respectively. Strangely, pushing the graphene layers further apart with these intercalant atoms makes the system more electronically isotropic. This work has generated a lot of theoretical activity, such as that by Gábor Csányi and collaborators. Their electronic structure calculations show that the electrons introduced into graphite through Yb and Ca doping do not behave conventionally. Instead of the graphene layers, they seem to prefer the void between the sheets. This would explain the increased isotropy, for example. **[Letters pages 39 and 42; News and Views page 17]**

MATTER-WAVES SPLIT ON A CHIP

The study of Bose–Einstein condensation provides insight into the fundamental nature of matter and could lead to the realization of practical devices such as ultraprecise gyroscopes. The prospects are improved by the use of atom chips, formed by integrating multiple components for manipulating a Bose–Einstein condensate onto a single platform. But success relies on the individual components being able to process a condensate without affecting its coherence. To this end, Peter Krüger and colleagues demonstrate an atom-chip device that can split a condensate in two while preserving its phase. Moreover, the device enables the distance between the two halves to be controlled so that they can be either brought close enough together to interact or be moved far enough apart so that each is isolated from the other. [**Article page 57**]

PUMPING QUANTUM WELLS FOR INFORMATION

The spin Hall effect holds promise for device applications in spintronics and quantum computing, thanks to the spin–orbit interaction; by applying an electric field, the confined electron spins can be manipulated precisely. But there are plenty of fundamental physics questions to keep researchers busy. For example, the mechanism could have several possible origins that are extrinsic and/or intrinsic to the AlGaAs quantum wells under investigation. With her collaborators, Vanessa Sih has imaged the spin Hall effect and current-induced spin polarization. The orientation of the two-dimensional electron gas was engineered to distinguish the two intrinsic effects under consideration, one being in-plane and the other out-of-plane. Their directional study indicates that neither is large enough to account for the out-of-plane polarization and that the extrinsic effect dominates. [**Letter page 31**]

TURBULENT SUPERFLUID FLOW

The superfluid phase of liquid ^{4}He — known as He(II) — can show surprising behaviour. Using particle imaging velocimetry, with micrometre-size polymer tracer particles, Tao Zhang and Steven Van Sciver have mapped out what happens when flowing He(II) meets a cylindical obstacle. The large-scale turbulent structures they observed are presumably caused by flow separation of the superfluid He(II) and its residual normal-fluid component, in line with the Landau two-fluid model for He(II). As in a classical fluid, macroscopic eddies were seen to form downstream, behind the barrier. But this is a quantum fluid, so expect the unexpected: Zhang and Van Sciver also saw eddies forming upstream of the obstacle. [**Letter page 56**]

HOW WET SAND GETS ITS STABILITY

The perfect recipe for building a sandcastle is eight parts sand to one part water. But how does the water stabilize the sand? To answer this question, Sarah Nowak and colleagues have performed a series of stability measurements using transparent rotating drums. Using different grain sizes, drum diameters and liquids, they recorded the angle of the drum before and after an avalanche. They propose a model that does not require any friction between the grains. Their model includes both surface and bulk effects of the pile, a hybrid approach that settles years of inconsistent results due in part to different system sizes. During an avalanche, clumps — rather than individual grains — tend to fall, which have a characteristic size, or coherence length. Could this be a connection to the collective behaviour found in traditional hard condensed-matter physics? [**Letter page 50; News and Views page 21**]

The perfect sandcastle?
p21

CRACKLING NOISE SKEWED BY INERTIA

Crackling noise is the phenomenon that arises when a system responds to a change in conditions through bursts of activity separated by periods of inactivity. Despite its occurrence in situations as diverse as earthquakes and the crumpling of paper, the statistical behaviour of the avalanche-like events that cause it has a remarkably universal character. The success of crude models which take little, if any, account of the microscopic details of such systems is also remarkable. Yet simulations of noise pulses emitted by a simple magnet when the direction of its field is reversed fail to predict the often skewed shape of the curve that reflects the timing and duration of the pulses. Claudio Castellano and colleagues address this by taking better account of the physical mechanisms and show that the asymmetry is due to the effective mass of the domain walls in the magnet. [**Letter page 46; News and Views page 13**]