Asteroids cross paths

Nature **467,** 814–816 (2010);
Nature **467,** 817–819 (2010)

Early in 2010, a puzzling comet-like object appeared in the asteroid belt between Mars and Jupiter. Instead of a nucleus with a tail of water vapour and ice, object P/2010 A2 had a detached tail of dust parallel to the main body. Nonetheless, it was classified as a comet — a somewhat 'headless' comet with a strange X-shape preceding the dust trail. Images obtained independently by Colin Snodgrass *et al.* and by David Jewitt *et al.* (using the Rosetta and Hubble space telescopes, respectively) suggest that P/2010 A2 is actually the result of two asteroids colliding.

The two groups modelled the position and angle of the trail, composed of dust and gravel particles larger than 1 mm in size, and showed that it originated from a single event in February/March 2009, which is surprising given the well defined debris trail; in fact, Snodgrass *et al.* pinpoint the collision to 10 February, plus or minus one week. The nature of the impact remains unclear, as does the mechanism for spreading dust (finer than 1 mm) throughout the Solar System and beyond.

Dimensional interplay

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In porous materials and in biological systems, molecules are often confined in a closed domain and react with target sites on its surface. The molecules undergo both surface-mediated and bulk diffusion, and it is not obvious how the time to reach the target is optimized: in the bulk, diffusion is faster but the search is less efficient than for explorations of the surface alone. To further complicate matters, the duration of bulk excursions is controlled by the probability that the molecule will be adsorbed on and desorbed from the surface — and this probability in turn is a function of the shape of the confining domain.

Olivier Bénichou and colleagues have modelled this intricate interplay. In their calculations, they find that the coupling of the adsorption–desorption dynamics to the geometry of the confining domain critically influences the reaction times. But this complication is not necessarily bad news: it implies that, in such systems, reactivity can be enhanced and controlled by tuning the desorption rate from the surface.

Pedestrians get in shape

Phys. Rev. E (in the press); preprint at http:/arxiv.org/abs/1008.4297 (2010)

Poor understanding of how crowds of people move through confined spaces can have catastrophic consequences. Inadequate design of the entry gates and surrounding areas of the Hillsborough football stadium in the UK was identified as one of the principle factors in the death of 96 people in 1989. More recently, failures in directing the flow of people into the Love Parade music festival in Duisburg, Germany, led to 21 deaths. To try to avoid such tragedies, Mochine Chraibi and colleagues have built a model that more accurately describes the motion, and in particular the shape, of pedestrians in a crowd.

Conventional force-based models of pedestrian dynamics predict the qualitative behaviour of crowds under normal circumstances relatively well. But they fail at the high crowd densities that arise during an emergency. These models usually treat pedestrians as circular disks of constant radius. Yet it is well known that the shape of the effective volume of a pedestrian changes with walking pace: at low speeds they take shorter steps and sway more than at high speeds. And so Chraibi *et al.* model them instead as velocity-dependent ellipses, and achieve better quantitative agreement with experimental data over a wide range of crowd speeds.

Up, up and away

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Ultrahigh-energy cosmic rays (UHECR) — with energies typically in excess of 10^{19} eV — are sought by ground-based telescopes such as those of the Pierre Auger Observatory in Chile. The latest observations, of 16 candidate UHECR, come, however, from the Antarctic Impulsive Transient Antenna (ANITA), a radio interferometer carried on balloon flights about 35 km above the Antarctic ice.

ANITA is picking up not the cosmic rays themselves, but geosynchrotron radiation generated as electrons and positrons in the atmospheric cosmic-ray shower spiral through the Earth's magnetic field. The geosynchrotron emission is partially or fully coherent at radio wavelengths. With a signal threshold set a few times higher than the power of thermal emission from the ice, ANITA can map the origin of the reflected geosynchrotron signal, and hence of the UHECR, back onto the sky with an error circle of about 2° in diameter.

Although the authors, Stephen Hoover *et al.*, admit that work is still needed on the precise modelling of geosynchrotron radiation, their study shows the potential of complementary UHECR studies at radio wavelengths in understanding the origin and spectrum of these cosmic rays.

All mixed up

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ISTOCKPHOTO / MATTEUSUS

Ocean mixing is an important process for marine ecosystems: it transports inorganic nutrients from stratified waters to surface layers and enables the transfer of gases between the atmosphere and deep waters. An intriguing question is, does the motion of marine animals contribute — so-called bio- or biogenic mixing? Alexander Leshansky and Len Pismen tackle the problem from a hydrodynamic perspective and show that the drift motion of animals such as krill or jellyfish is a vital consideration.

Their work builds on that of Kakani Katija and John Dabiri (*Nature* **460,** 624–626; 2009) who highlighted the importance of a mechanism put forward by Charles Darwin's grandson: "When a solid body moves through an incompressible fluid, it induces a drift in the fluid." Katija and Dabiri showed that this drift phenomenon has a greater influence than the turbulence caused by large sea animals.

Leshansky and Pismen corroborate this idea by examining the hydrodynamics of the drift induced by self-propelled objects: unlike passively towed bodies, a steadily self-propelled swimmer generates no net momentum flux. They confirm that the large number of such drifters compensates for their small size.

Correction

In the version of the Research Highlight 'All mixed up' originally published (*Nature Phys.* **6,** 836; 2010), the surname of the author Len Pismen was spelt incorrectly. This has now been corrected in the HTML and PDF versions 10 November 2010.