Battle of the bulge

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For the known supermassive black holes residing at the centres of massive galaxies, the mass of the black hole is usually 0.1% that of the galactic bulge — the high-density central group of stars in a galaxy, which are normally old, red and of low metallicity. Moreover, the black-hole mass and the velocity dispersion of the stars found in the bulge are empirically related.

So it's a surprise that Remco van den Bosch and colleagues have found a black hole weighing in at 59% of the bulge mass of its host galaxy, NGC 1277, in the constellation Perseus. Based on the average dispersion of 333 km s^{-1}, the predicted mass should be an order of magnitude lower.

Previously, the heavyweight was the black hole in the dwarf galaxy NGC 4486B, at 11% mass. There are, however, five more dense galaxies with high-velocity dispersions, which might host similarly over-massive black holes yet to be observed. Is NGC 1277 an outlier, by 2.1 standard deviations, or will astronomers need to revise the current models of galaxy evolution and black-hole mass relations? *MC*

Sisyphus again

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Atoms and molecules behave very differently near absolute zero than they do at everyday temperatures. Techniques for cooling atoms and diatomic molecules to such low temperatures have therefore opened an entire new field of physics. Martin Zeppenfeld and co-workers now demonstrate a cooling procedure that can be applied to molecules of three or more atoms, and use it to cool fluoromethane (CH_3F) molecules to 29 mK.

Usually atoms are cooled using lasers, which requires that the atoms have a particular energy structure. But the requisite transitions do not exist in polyatomic molecules. Instead, Zeppenfeld *et al.* tailored the electric field in which the CH_3F molecules were trapped to adjust the energy levels of the molecules, making laser-cooling possible.

The process is known as 'Sisyphus cooling', because it needs to be continuously repeated to attain low temperatures — just as the king from Greek mythology was cursed to eternally roll a boulder up a hill, only for it to roll back down again. *DG*

Branching out

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The BaBar detector collected data at SLAC's PEP-II electron–positron collider from 1999 until 2008. Analysis of that data continues, and J. P. Lees *et al.* now present some precise measurements involving bottom (*b*) quarks that have implications more widely in particle physics.

BaBar picked up the decay products from the pair of *B* mesons (which contain *b* quarks) created in the specially tuned PEP-II collisions. By carefully selecting those interactions that produced a photon — when a *b* quark decays radiatively to a strange quark — Lees *et al.* have extracted the 'branching fraction' for $B \rightarrow X_s\gamma$ (where X_s may be anything that contains a strange quark). They've also measured the direct CP-asymmetry for decays involving down as well as strange quarks.

These quantities are determined by Feynman diagrams that contain loops — and those loops could involve new physics. BaBar's results, however, are consistent with standard-model predictions and hence constrain new physics, including certain models for families of Higgs bosons. *AW*

Gone in a flash

Nature Photon. http://go.nature.com/qKGoRO (2012)

How many electrons can be kicked out of a xenon atom by an intense X-ray pulse? It seems the answer is more than theory would allow. Benedikt Rudek and colleagues have found unexpectedly highly charged xenon ions created in photo-ionization experiments using an X-ray free electron laser — the Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory.

A short 1.5-keV X-ray flash can eject up to 36 electrons from a xenon atom — that is, two thirds of the total number. However, a sequential ionization process of one-photon absorption steps would only account for the ejection of 26 electrons, and at 2 keV an ionization limit of 32 electrons is supported by both theory and observations. From a comparison of experimental data with new calculations, Rudek *et al.* suggest that a previously unknown absorption mechanism — transient and resonance-enhanced — is responsible for the generation of the unusually highly charged ions, explaining why this occurs only at a certain energy.

Rudek and colleagues predict that transient resonance-enhanced absorption is in fact a general mechanism for the intense X-ray-induced ionization of heavy atoms — which could have implications for the creation of very highly charged dense plasmas and the diffractive imaging of samples containing heavy atoms. *IG*

Don't be too careful

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In August 2010, a Chinese traffic jam spanning over 100 km lasted more than 12 days. Research into how such a state might be avoided has highlighted similarities with other jammed systems. Now, simulations by Astrid de Wijn and colleagues have shown that over-cautious driving — motivated, for example, by extreme weather conditions — may induce a dynamical transition resembling the onset of glassiness.

The fact that traffic jams generally have a typical size and finite correlations has hampered attempts to define criticality precisely in these systems. But kinetically constrained models for glassy systems are readily applicable to the problem, in that the dependence of each car's acceleration on that of the one in front provides a natural kinetic constraint. De Wijn *et al.* found that as density increased, cars decelerated according to this constraint, creating jams and lowering the average velocity of the system.

The dynamic susceptibility, indicating the size of regions of correlated mobility, diverged in their simulations, together with the correlation timescale — inducing the sort of persistence that leads to record 12-day jams. The transition occurred in the limit associated with over-zealous braking, and led to coexistence of free-flowing and jammed traffic, in analogy with a thermodynamical critical point terminating a two-phase regime. *AK*

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