ASTEROIDS

Spun into shape

Icarus http://doi.org/cs7v (2018)

Credit: Art Directors & TRIP/Alamy Stock Photo

It's tempting to think of celestial bodies as shiny spheres gracing the sky. Alas, many asteroids don't quite fit that romanticization. They often come as irregularly shaped rocks. The larger of these are thought to have been beaten into shape mainly by collisions, but smaller asteroids may also owe their form to earlier break-ups due to rapid spinning. To better understand the effect of rotationally induced failure, Masatoshi Hirabayashi and Daniel Scheeres numerically studied the deformation modes of 24 well-documented asteroids of less than 40 km in diameter.

The spin state of small astronomical bodies can change as a consequence of long-term exposure to solar radiation pressure. And once the rotational speed exceeds a critical value, the body fails. In their finite-element analysis, Hirabayashi and Scheeres showed that the spin at which this happens and the region where the structure fails depends strongly on the original shape of the asteroid. *AHT*

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EVOLUTIONARY DYNAMICS

You say tomato

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Modern languages are changeable beasts. New conventions emerge frequently to alter the way we communicate with one another. But how does the pathway to change — be it self-organizing or institutionally imposed — affect the pattern of uptake of a language norm? According to Roberta Amato and colleagues, the mechanism by which a change occurs leaves distinct traces in the printed word — as they found when they examined more than 2,000 norms in English and Spanish books published between 1800 and 2008.

Amato et al. looked at the way that changes brought about by formal institutions like the Royal Spanish Academy differ from those enacted informally, such as spelling changes popularized by dictionary updates. They compared these mechanisms with cases of spontaneous evolution, like the adoption of American 'garbage' in place of British 'rubbish'. A simple evolutionary model led the authors to conclude that the influence of a formal institution makes for a sharp transition, whereas spontaneous uptake relies heavily on mechanisms of imitation and reproduction. *AK*

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DIRAC MATERIALS

Beyond perturbations

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Theoretical descriptions of interacting particles can become very difficult when perturbation theory does not apply. This is the case for the Coulomb interactions between electrons in graphene and so most previous work has focused on either the short- or long-range limit. This isn't ideal because a realistic situation will combine elements of both. Ho-Kin Tang and co-workers have performed detailed, non-perturbative numerical simulations to include both effects, allowing much more accurate predictions for the properties of graphene and other Dirac materials.

Their results show that both a semimetallic phase and an insulating phase are accessible by varying parameters such as the dielectric environment, the strain in the lattice or the density of electrons. They also explain why the Fermi velocity measured in experiments is often higher than that predicted by ab initio calculations. Various Dirac materials fall in different parts of this parameter space, accounting for the range of behaviour observed in experiments. *DA*

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TOPOLOGICAL ELECTRONICS

Shaping a quantum chain

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The deterministic arrangement of atoms in two dimensions promises opportunities for quantum electronics. In addition to tuning conductors into insulators, researchers have long sought to take control over the quantum properties of 2D materials, as their synthesis has reached atomistic precision. Now, Oliver Gröning and co-workers have designed graphene nanoribbons, in which the electronic structure of sub-elements features local quantum states that can be connected in a chain to form a unique band structure.

Synthesizing the nanoribbons from molecular building blocks on a single crystalline surface, Gröning et al. demonstrated that the exact adjustment of the width of the structure is key to the formation of stable and coupled topologically protected quantum states. Such nanoribbons might find applications as nanotransistors, or as qubits for quantum computers. In a related report, Daniel Rizzo and colleagues made use of the same principle of band engineering, thus demonstrating the power of tailor-made topological interface states. *JPK*

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COLLECTIVE BEHAVIOUR

Ignorance is strength

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When making decisions in a competitive environment, access to comprehensive prior information should intuitively confer an advantage. This is the rationale behind the accumulation of big data: we expect that the more information we store, the better our predictions.

As Vijayakumar Sasidevan and colleagues have now shown, the relationship between information availability and prediction accuracy is in truth much subtler. They considered an adaptive system composed of agents that compete for a scarce resource, making decisions on the basis of previous outcomes. By varying the ratio between agents that have access to good or poor data — in terms of the length and resolution of their record — and the details of their strategy, they concluded that better information availability doesn't always lead to a larger payoff.

The origin of this phenomenon, the authors argue, resides in the collective information that is available only at certain level of coarse-graining of the data, which might vanish at higher resolution. *FL*

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